THE ANNUAL REPORT

of the

Northeastern Forest Experiment Station

1947

Northeastern
Forest Experiment Station
Upper Darby, Pa.
V.L. Harper, Director

NORTHEASTERN FOREST EXPERIMENT STATION
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CONTENTS

	Page
Introduction	1
Flood control surveys	10
Forest survey	12
Forest Utilization Service	17
Cooperative farm forestry research	22
Forest economics studies	24
Forest management research	26
Developments in spruce budworm	26
Silviculture	31
Management	38
Mensuration	40
Forest regeneration	41
Forest genetics	44
Publications	51
Technical personnel	55
Northeastern Forest Research Advisory Council	57

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January 1, 1948

INTRODUCTION

Looking back over the happenings of 1947 for those that had a special bearing upon forestry in the Northeast, one sees several prominent features stand out.

One was the series of calamities that began with destructive springtime floods in many parts of the region. Then, as the summer came on, there was severe drought. Thousands of headwater streams in northern New England that seldom go dry did so in the past summer. In Maine the reduced streamflow at hydroelectric plants caused a critical power shortage that threatened stoppages of manufacturing plants. This was avoided only by feeding power into the transmission system from the generators of naval vessels. Elsewhere, the extreme low water in rivers greatly aggravated pollution conditions.

The final disaster came in the form of terrible forest fires throughout the Northeast and particularly in Maine. These were, by far, the worst fires that Maine has ever had since organized fire protection began. They covered about 200,000 acres of timbered lands, wiped out 9 small towns and damaged 4 others, destroyed over 1,000 homes that sheltered at least 2,500 persons, and caused 16 deaths. The total damage has been estimated at about $30 million. This is probably conservative because much land highly valuable for timber production, recreation, and for watersheds has been severely damaged and will be affected for a long time to come. Salvage of burned timber and the regeneration of a new timber stand will require considerable attention in the years immediately ahead. In the other northeastern states, the fire danger became almost as bad as it was in Maine. There were many fires but, fortunately, all were brought under control before great and extensive damage was done.

This recent experience with floods and drought and fire emphasizes the fact that the management of forest lands involves much more than timber production alone. The relation of forests to waters is extremely

important and obvious enough to anyone who will think about it. The mean annual precipitation in the Northeastern States ranges from 30 inches in northern New England, to 40 and 50 along the seacoast, and up to about 80 on some of the highest elevations. This means that between 4,000 and 5,000 tons of water fall on each acre of ground in the course of the average year. The mechanical power exerted by this much water to push soil particles downhill is almost beyond comprehension. Fortunately, more than half of it falls on ground that has, or should have, a forest cover. It is also fairly well distributed throughout the year. About half of the precipitation either returns to the atmosphere through evaporation or percolates into the soil where it works its way through underground channels where its erosive action is almost nil. The remainder finds its way into streams as surface runoff.

The great abundance of water in the Northeast is one of the principal reasons for the advanced stage of this area's economic development. The early factories were powered by waterwheels. Important industries like textiles and pulp and paper require huge quantities of water in their processing operations. Great metropolitan cities require millions of gallons per day for domestic uses. A tremendous quantity of human and other wastes would soon accumulate and make life in congested areas intolerable were it not carried away by the flowing streams. Inland waters provide water transportation, hydroelectric power, habitat for aquatic life, and opportunities for some of our best recreation.

Any analysis of the values of water resources seems puny because water and life go hand in hand. However, in spite of this obvious fact, men have tended to be extremely careless about the management of water resources. Watersheds stabilized by millenniums of forest and other vegetative growth have carelessly been stripped of their cover; lands too steep for safe cultivation have been exposed by the plow; streams once clear as crystal have been loaded with silt and shamefully polluted by sewage and industrial wastes. The result is the destruction of many of the values that lie in these water resources.

All of the intricate relationships of land and water are by no means fully known. It has, however, long been recognized that well-forested watersheds are a highly important factor in regulating the flow of headwater streams. The duff on the forest floor acts as an absorbent sponge to hold excess precipitation or the water of melting snow and gradually to feed it into underground reservoirs from which it later finds its way out in springs or by seepage into streams and lakes. The flood control thus obtained by forested watersheds is fully as effective as the dams and levees that may be used on the lower reaches of rivers.

The dramatic devastation caused by floods tends to center attention upon the evils of too much water. Hydrologic studies show, however, that the problems of too little water are fully as critical. In basin after basin, stream pollution is the number one problem. It becomes especially bad in those months of low water when the volume of streamflow

is not sufficient to dilute sewage and other wastes to that point where natural oxidation is possible. Waters in this condition are not only offensive but dangerous. Well-forested lands, managed with proper attention to their watershed values, can do much to alleviate such problems. The reduction of runoff in the spring flood season means that a part of the water is retained and that it continues to feed into the streams even when a high rate of evaporation or low precipitation would otherwise cause a stoppage of the surface runoff.

The great majority of the people of the Northeast live in cities where they are dependent upon public water supplies. Many of these public water systems were established long ago when cities were small and rivers were relatively clean. With the passage of time the problem of public water supply has become more and more critical. The reclamation of impure water drawn from rivers has become an increasingly difficult and expensive job. Even though it is possible by filtration and chemical treatment to make these waters safe for human use, they usually retain offensive odors and tastes. There is a growing demand for upland water supplies that require only very light treatment. A very considerable acreage of forested land is, no doubt, destined to be turned to primary use as public-water-supply watersheds.

Are we really equipped with knowledge to properly manage these watersheds to yield their optimum in usable water? Our present program of forest research is giving considerable attention to flood-control surveys and to outlining remedial measures in aid of flood control, but almost none to the fundamental field of forest influences upon the behavior of water. A research program in this field is greatly needed.

The recent fire experience has put a decided damper on some of the satisfaction that formerly prevailed with regard to the status of fire protection. Organization and equipment reasonably adequate to meet the needs of normal years proved to be pitifully deficient when confronted by last summer's conditions. Such conditions may recur at any time--when they do it is not possible to improvise an effective protection system.

The monetary losses sustained in the Maine fires of last summer would have paid for better fire protective organization over many years. The Conference of New England Forestry Officials has presented a series of recommendations to the New England Governor's Conference. They propose that each state centralize resposibility for forest fire protection in its state forestry organization and that this agency be given complete legal jurisdiction in the fighting of forest fires 1/; that the several New England States cooperate in setting up an interstate fire-control

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1/ In many states the organized towns are responsible for forest fire protection within their respective boundaries.

authority; that the interstate authority in cooperation with the individual states set up a comprehensive fire-control plan in consultation with a committee of representative citizens. The main elements of this plan would include the maintenance of trained fire-fighting personnel, the establishment of training schools, and the maintenance of fire-season ground-patrol forces. Equipment recommended includes fire towers, two-way radio communication systems, airplanes for reconnaissance and for transport of men and equipment, and modern power pumpers. The Forestry Officials also recommend programs of education and of research on fire prevention and supression. These recommendations will, no doubt, be carefully considered by the New England States.

Relaxing from the prolonged pressures of the war years, the people were able in 1947 to resume some of their prewar summer and week-end vacation habits. Winter sports also revived. This renewed opportunity for recreation brought with it a new appreciation of the importance of the recreational value of forest. The New England Council, in a statement submitted to the House Committee of Agriculture, estimated that the cash income derived from forest recreation is about equal to that obtained by the harvest of timber products. This statement is probably valid for the entire northeastern region. The years immediately ahead will certainly bring a revival of surveys of recreational needs and of land planning to meet those requirements.

The new interest in recreation involves the conservation and restoration of wildlife. Federal funds for cooperation with the states in the program authorized in the Wildlife Restoration Act of 1938 2/ were restored to a peacetime basis after the drastic curtailment due to the war. This permitted a resumption of wildlife research in many of the states. The Federal program in this field is under the jurisdiction of the Fish and Wildlife Service of the Department of Interior. In West Virginia the Station, through its forest-survey activity, is cooperating with the state by combining a survey of game habitat with one of timber resources. There will, of course, be continued close cooperation between forestry research and wildlife research.

Other significant happenings: In the last general election, the people of West Virginia approved an amendment to their State Constitution providing that

> ".....the Legislature may by general law define and classify forest lands for cooperation by contract between the state and the owner in the planting, cultivation, protection and harvesting thereof. Forest lands embraced in any such contract may be exempted from all taxation or be taxed in such manner,

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2/ Also known as the Pittman-Robertson Act.

including the imposition of a severance tax or charge as trees are harvested, as the Legislature may from time to time provide ..."

A special committee is now working on the drafting of legislation that will be submitted to the 1949 session of the Legislature. Forest taxation also received attention in Maine where the State Tax Assessor, with cooperation of the Forest Service, carried out a "case study" of forest land taxation in selected towns of Hancock County 3/. Still another evidence of the active interest in forestry matters in West Virginia is the recently-organized Forest Council representing all the major interests concerned with forest land use. The Council is developing a well-balanced program of studies and educational activities. In the State of Maryland, the law that gives the State Forester powers to prescribe and enforce cutting-practice rules has been upheld in its first test in the courts. This is one of the best regulatory laws that has yet been put on the statute books of any state. Its judicial confirmation is of first-rate importance for the cause of improved forestry. The State of New York is now in process of reorganizing its rules of forest practice and its administrative machinery for bringing them to the attention of landowners who wish help. The New England Council told a committee of the Congress that, "The need for determining and developing a sound practical basis for establishing forest practice standards for the New England forest lands is apparent and should be undertaken by the forest industry in cooperation with public agencies".

Still another dominant feature of the forestry landscape in 1947 was the intensified interest in timber production. The demand for all timber products remained at a high level. Procurement of labor and equipment became considerably easier. This tended to focus more attention upon the tightening raw material situations and to stimulate more determination to deal with the causes thereof. Requests for forest survey information have increased. More trained foresters were working in the woods than at any time in the past. Forestry meetings of all kinds were well attended. There was a growing interest in mechanized logging and in the improvement of utilization in the woods and in the mills. A group of pulp companies organized their own research agency to test new harvesting methods and equipment. Several private owners offered to put blocks of their timber land under lease to this Station for experimental forests.

Rising interest in timber production does not mean, however, that the Northeast is now on the highroad to timber abundance. The wide disparity between regional consumption of lumber and lumber production from northeastern forests was emphasized in last year's report. It can be reiterated here:

3/ Malone, Paul E. Forest taxation in Hancock County, Maine. Maine Bur. Taxation. 46 pp., illus. Augusta. 1947.

"In the 20-year period 1922-42, New England produced only 35 to 50 percent of the softwood lumber it consumed. The Middle Atlantic States produced only 2 to 10 percent of what they needed. In hardwood lumber the region did a little better: New England produced between 50 and 75 percent, and the Middle Atlantic States about 33 percent".

Current statistics on regional consumption of lumber are not available, but it is well-known that the situation has not changed materially--it is probably worse because of the huge demand for construction lumber.

The low level of production from northeastern forests is evident again when we examine the operations of the paper and paperboard manufacturing industry in 1946. The mills of the Northeastern States last year produced 6.8 million tons of paper and paperboard or 35 percent of the total national output. Of the higher grades of paper, they produced more than half of the national output. In the manufacture of this paper and paperboard, the northeastern mills consumed 7.2 million tons of fibrous materials. Only 26 percent of this total came directly from pulpwood cut from the forests of the region. The requirements for new wood pulp had to be met by importations of pulpwood and of manufactured pulp that amounted to 28 percent of the fibrous material consumed. The imported wood came from Canada. The pulp came from Canada, Europe, and from other regions of the United States. The remaining fibrous materials consumed by the paper and paperboard mills consisted of waste-paper pulp (40 percent) and of pulp made from straw, rags, bagasse, etc. (6 percent).

The over-all picture of fibrous material supplies of the paper and paperboard industry is shown graphically in figure 1. If all of the new wood pulp used in 1946 had been produced from wood cut from the forests of the Northeast, the cut would have been about 5.8 million cords. The actual production was 2.6 cords. Here was a deficit of 3.2 million cords. There is ample reason for concern about the long-term outlook for the supply of fibrous raw materials for the northeastern paper and paperboard industry.

This concern is sharpened by the fact that the Province of Ontario, Canada, from which a substantial part of our pulpwood imports has been coming, has officially announced that pulpwood exports are to be progressively reduced by 10 percent a year and finally halted altogether at the end of the coming decade. Other Provinces are likely to follow suit within the not-far-distant future.

The total prospect in the pulpwood supply situation indicates that there should be a vigorous effort to increase the growth of the favored pulpwood species (spruce and fir), while at the same time every feasible way to increase the use of the more abundant hardwoods for pulp making should be tried.

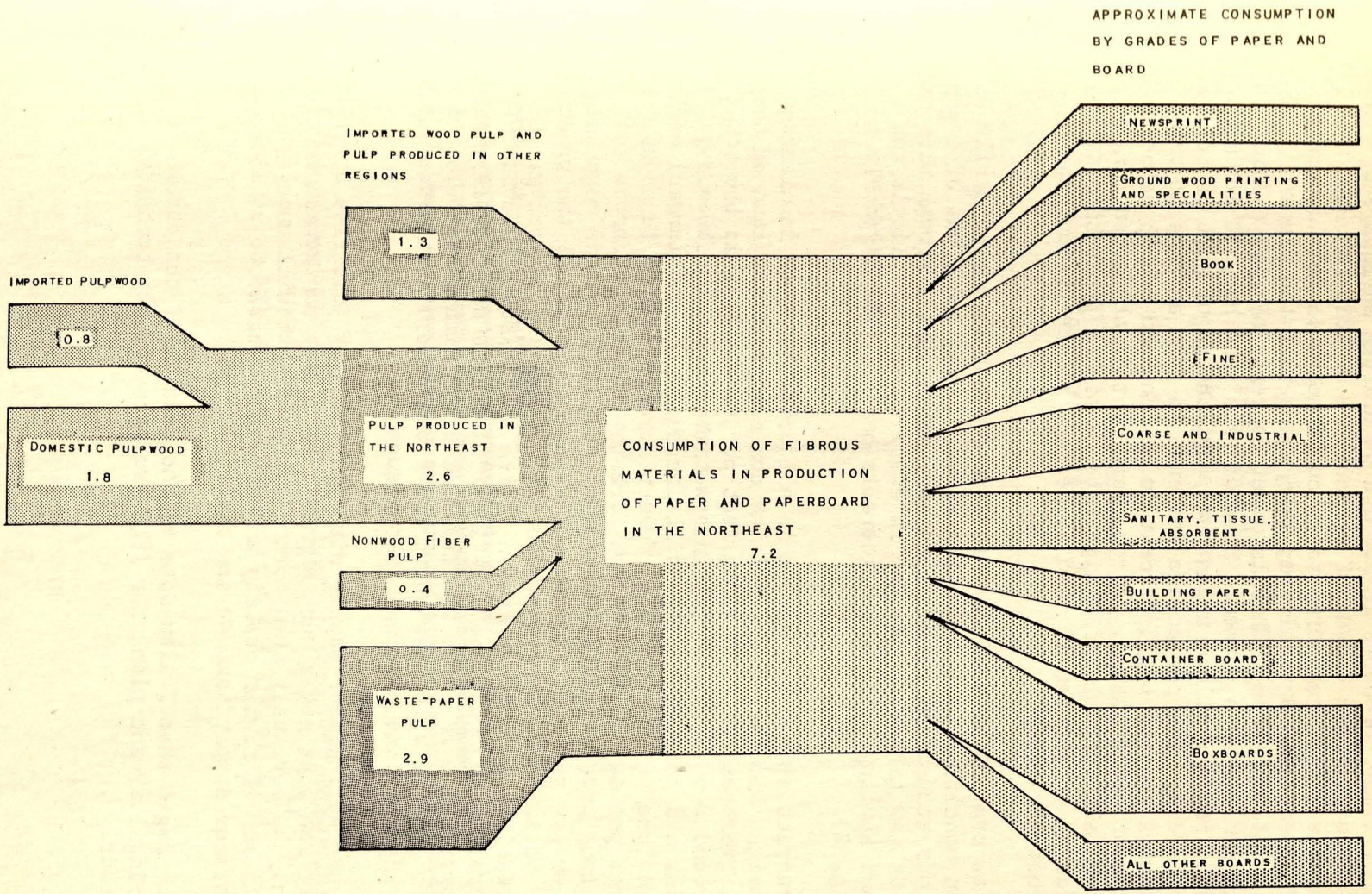


Figure 1.--Sources and kinds of fibrous materials used in the manufacture of paper and paperboard in the Northeastern States, 1946. Pulpwood is in terms of equivalent pulp tonnage.

This critical situation with regard to regional supplies of the higher-quality timber products is not due to drastic shrinkage of the forest land acreage. The Census of Agriculture of 1880 reported that the farms of the 12 Northeastern States contained 84.4 million acres of land. The Census of Agriculture, 1945, shows that the present farms contain 62.7 million acres. This is a net decrease of 21.7 million acres in the area that is farmed. Some of this land has, of course, been turned to industrial and urban uses, but the major part of it has returned to forest. The percentage decrease in farm acreage in the 1880-1945 period amounts to 33 percent in New England and 23 percent in the Middle Atlantic States. A good part of this abandoned farm land is potentially capable of a high rate of timber production. It probably adds up to between 10 and 15 percent of the present commercial forest acreage.

The low productivity of northeastern forests is due primarily to the run-down condition of the growing stock. Less than 2 out of every 5 acres of our commercial forest land now bear a forest growth that can be classed as saw timber. One acre in every three bears little but seedlings and saplings, and a considerable part of this is poorly stocked (fig. 2).

The current net annual growth in all trees 5 inches in diameter at breast height and larger, on all the commercial forest land of the Northeast, averages about 30 cubic feet per acre. This is the total volume of round wood. The growth in saw-timber trees (softwoods 9 inches d.b.h. and larger, hardwoods 11 inches d.b.h. and larger) when averaged over the total commercial forest acreage amounts to about 60 board feet per acre. The managed forests of northern Europe and Japan have long produced an average growth per acre that is more than twice what we are getting. Without presuming to go in for the practice of forestry on anything like the European or Japanese intensity, it should be possible to step up growth in the Northeast to 40 cubic feet per acre and to boost the saw-timber increment to about 135 board feet per acre. This is about the level of production that would bring northeastern forests up to the point where they would contribute their reasonable share to the national timber supply.

This over-all timber-supply situation clearly justifies a forest research program that gives much emphasis to forest management and forest utilization. We obviously need more "know-how" that will enable us to grow more timber of higher quality and make it possible to utilize more fully the timber supply that we now have.

In the pages that follow some of the results of the Station's program during 1947 and plans for 1948 are presented, by technical subject matter.

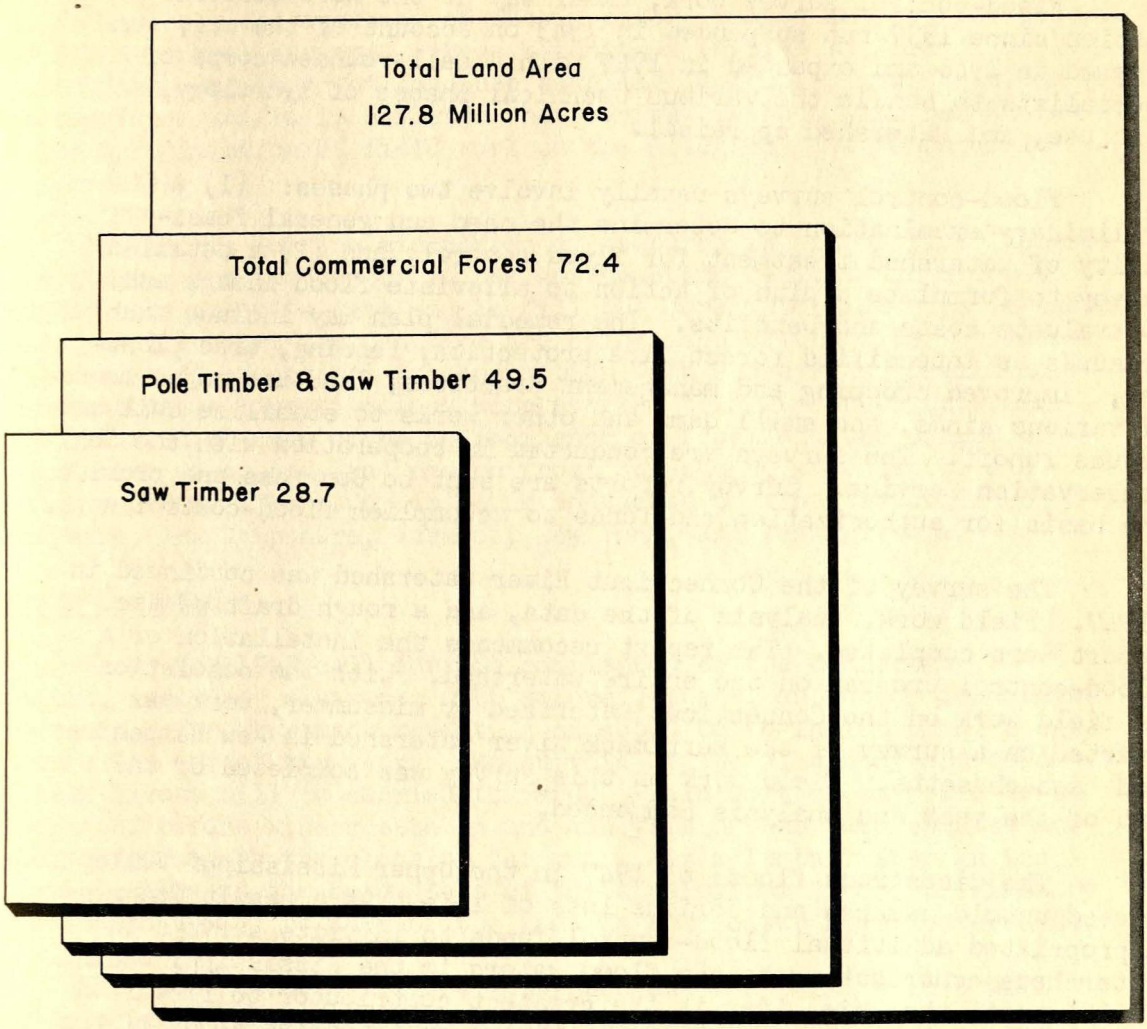


Figure 2.--Less than 2 out of every 5 acres of commercial forest land in the Northeastern States now bear forest growth that can be classed as a saw-timber stand.

FLOOD-CONTROL SURVEYS

Flood-control survey work, under way at the Northeastern Station since 1937 but suspended in 1943 on account of the war, was resumed in 1946 and expanded in 1947 with a well-rounded corps of specialists to handle the various technical phases of hydrology, land use, and watershed appraisal.

Flood-control surveys usually involve two phases: (1) A preliminary examination to determine the need and general feasibility of watershed treatment for flood control, and (2) a detailed survey to formulate a plan of action to alleviate flood damage and to evaluate costs and benefits. The remedial plan may include such measures as intensified forest fire protection, fencing, tree planting, improved cropping and management practices, land-use adjustments of various kinds, and small dams and other works to stabilize soil and reduce runoff. The surveys are conducted in cooperation with the Soil Conservation Service. Survey reports are sent to Congress and provide the basis for authorization and funds to accomplish flood-control work.

The survey of the Connecticut River watershed was continued in 1947. Field work, analysis of the data, and a rough draft of the report were completed. The report recommends the installation of a flood-control program on the entire watershed. With the completion of field work on the Connecticut watershed by midsummer, work was started on a survey of the Merrimack River watershed in New Hampshire and Massachusetts. Field work on this survey was completed by the end of the year and analysis commenced.

The disastrous floods of 1947 in the Upper Mississippi Valley caused untold damages and serious loss of life. As a result Congress appropriated additional flood-control funds to initiate surveys in watersheds contributing to the flood waters in the Mississippi Basin. In the East, the Ohio River is the greatest contributor to floods on the Mississippi River. The Station started an intensive study of the rivers that go to make up the Ohio River.

A preliminary examination was made of the Monongahela watershed, and a detailed survey was recommended for that area. A survey of the Allegheny watershed had previously been authorized. These two rivers, coming together at Pittsburgh in the famous and often flooded Golden Triangle, form the Ohio River. With the additional funds provided, work was started on surveys of these important watersheds.

The Soil Conservation Service conducted several watershed surveys to which personnel from the Northeastern Station have been assigned to assist in the analysis of forest conditions, the development of a forest program, and the evaluation of costs and benefits of such measures. These watersheds were the Youghiogheny in Pennsylvania and Maryland, the Roanoke in Virginia and North Carolina, and the Lower Arkansas in Oklahoma and Arkansas.

With the commencement of field work in the Merrimack watershed new techniques for the determination of land-use conditions and the development of the land-management program were tested. The objective is to increase the accuracy of the inventory phases and to reduce costs of flood-control surveys. These techniques involve the use of aerial photographs and improved land-use sampling designs. Investigations will be continued and it is expected that various methods will be tested prior to initiation of field work on the Allegheny and Monongahela watersheds.

Basic data for the evaluation of measures in aid of flood control are limited and inadequate in the Northeastern region. In order to supply more adequate data and to fill the more important gaps in basic data special short-term studies are being made of the water cycle as related to flood control in conjunction with surveys and preliminary examinations. Investigations were started this winter to determine the relation of snow cover to incidence of frost and the effect of vegetative cover and land use on frost structure, snow depth, and water content. The study is being conducted on plots established in Maine, New Hampshire, Vermont, New York, and Pennsylvania.

Plans for 1948

Plans for 1948 call for the completion of the Connecticut report, including clearance with Federal, state, and other interested agencies. The Merrimack report is expected to be in its final stages before the end of the year. The surveys of the Allegheny and Monongahela Rivers will be carried forward. Field work is expected to be completed before winter sets in and analysis of the data started and well under way by the close of the year. As a further step in the investigation of the headwaters of the Mississippi River, preliminary examinations will be made of the Kanawha and Beaver River watersheds.

The frost studies will be continued and a special effort will be made to collect field data during the critical snow-melt period in the spring. It is hoped that we will be able to start studies dealing with soil moisture, soil-moisture depletion, percolation, and infiltration rates.

Our flood-control survey work in 1948 will be largely concentrated on the headwaters of the Ohio River watershed.

FOREST SURVEY

During 1947 field inventory work was carried on in New Hampshire, Vermont, New York, Pennsylvania, and West Virginia. By December 31, 1947, more than 10 million acres had been covered (fig. 3).

Excellent cooperation has been given by various State agencies and private interests. They have been anxious to obtain detailed estimates for local areas and the early survey of their states. Aerial photo contact prints have been furnished, new aerial photography arranged, manpower provided, and even some cash alloted. The estimated cash value of cooperation arranged to date exceeds $160,000.

With the expectation that Congress would continue to appropriate the full forest survey authorization, work was initiated in six cooperating states. Efficient field organizations were developed in the northern and southern portions of the region. Unfortunately, a reduction last year in appropriation by Congress required a scaling down of activity on July 1 by more than 40 percent. A large share of the cut has been absorbed in our headquarters office. Later on it will be necessary to reduce the size of the field organization in order to catch up on compilation of data and assure the issuance of reports for the areas inventoried.

Maine Forest Fire Damage Survey

The principal activity in Maine during 1947 was a survey of the larger areas burned over by forest fires in October. Detailed maps were prepared from aerial photographs showing the location of the pole-timber and saw-timber tracts within the burned-over areas; forest type and fire intensity were also indicated. A field survey provided the basis for tabulations showing the acreage of each tract and an estimate of the average volume per acre in each principal classification. These maps have been used by farm foresters, consulting foresters, and timber operators in arranging for the salvage of fire-killed timber.

The forest fire damage survey revealed that there was about 150,000 acres of forest in the five principal fire areas. The intensity of the fires in these areas is shown by the fact that only about 1 percent of the area was left in unburned islands. More than 50 percent of the white pine, the principal species in southwestern Maine, was either killed outright by the fires or was severely damaged. Altogether, there was more than 200 million board feet of saw timber wirhin the burned-over areas. A large portion of this volume is being removed in salvage operations.

Forest Taxation Study

In June 1947 the Bureau of Taxation of the State of Maine pub-

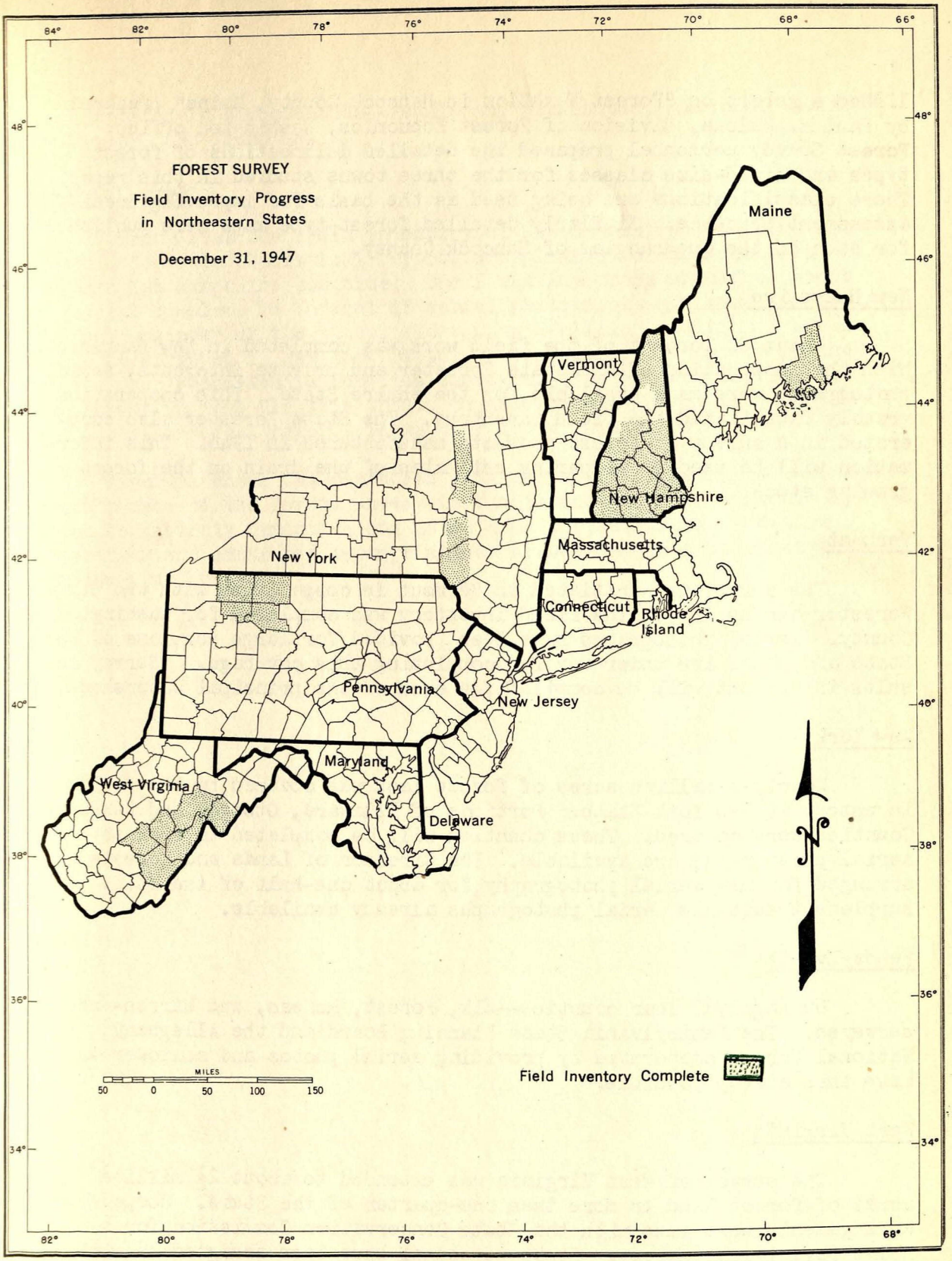


Figure 3.--The forest survey's field inventory has covered more than 10 million acres.

lished a report on "Forest Taxation in Hancock County, Maine" prepared by Paul E. Malone, Division of Forest Economics, Washington office. Forest Survey personnel prepared the detailed delineations of forest types and stand-size classes for the three towns studied in this report. These classifications are being used as the basis for improving local assessment practice. Similarly detailed forest-type maps were published for each of the quadrangles of Hancock County.

New Hampshire

About 80 percent of the field work was completed in New Hampshire. With the cooperation of the State Forester and private interests, aerial photographs were made available for the entire State. This cooperation greatly facilitated the field inventory. The State Forester also cooperated in a survey of forest products manufactured in 1946. This information will be used in preparing estimates of the drain on the forest growing stock.

Vermont

The survey was initiated in Vermont in cooperation with the State Forester during 1947. The field inventory was completed for Washington County. Aerial photographs have been provided for large portions of the State and plans are under way for completing this coverage. Survey results in Vermont will be compiled for each of the principal watersheds.

New York

Nearly a million acres of forest land was covered by the field inventory in New York State. Portions of Delaware, Otsego, and Herkimer Counties were covered. These counties will be completed as soon as aerial photographs are available. The Director of Lands and Forests has arranged for new aerial photography for about one-half of the State to supplement suitable aerial photographs already available.

Pennsylvania

During 1947 four counties--Elk, Forest, McKean, and Warren--were surveyed. The Pennsylvania State Planning Board and the Allegheny National Forest cooperated by providing aerial photos and manpower to make this survey possible.

West Virginia

The survey of West Virginia was extended to about 2½ million acres of forest land or more than one-quarter of the State. Cooperative arrangements were made with the State Conservation Commission for a joint forest-game survey. State personnel have been assigned to work on the forest survey and the survey has been extended to include data needed for an analysis of game habitat. The inventory phase of the survey

was completed in six counties--Pendleton, Pocahontas, Randolph, Webster, Greenbriar, and Nicholas.

Plans for 1948

During 1948 the field inventory of New Hampshire should be completed. Separate statistical reports are planned for the southern and northern New Hampshire counties. The field inventory should be about 80 percent complete in Vermont if aerial photographs are made available for the remainder of the State. More than 2 million additional acres should be surveyed in New York State. A statistical report is planned for the four Pennsylvania counties surveyed. The cooperative forest-game survey in West Virginia should be near completion by the end of 1948 and statistical reports issued for two groups of counties.

Figure 4 shows the tentative program for field, compilation, and report phases of the forest survey in the Northeast. The schedule by states is entirely tentative and based upon our estimates of future cooperation and continued appropriations by the Congress at about the same level as now.

Tentative Program for Field, Compilation, and Report Phases of the Forest Survey in the Northeast

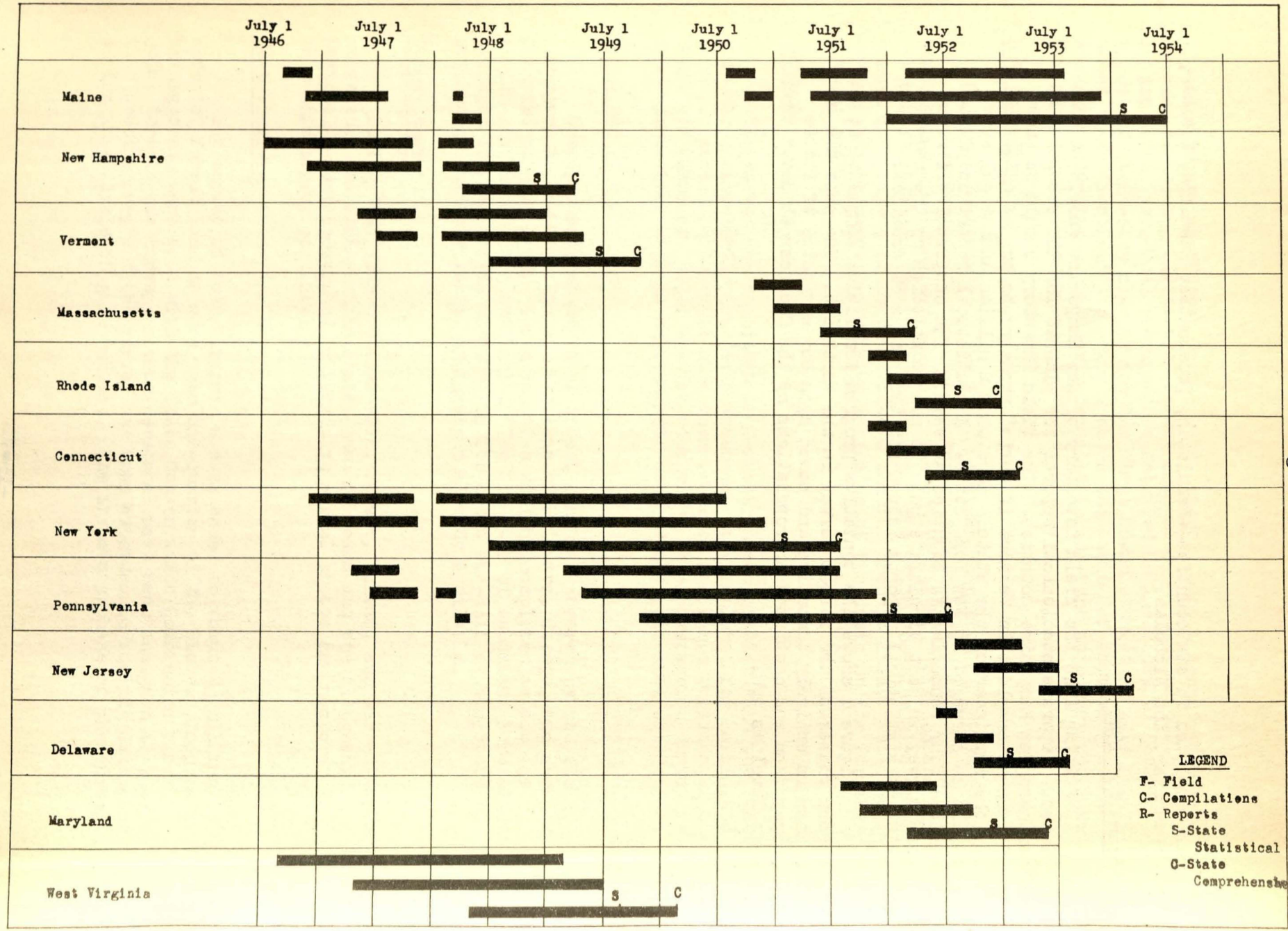


Figure 4

FOREST UTILIZATION SERVICE

Advertizing that we see in the glossy magazines and hear over the radio tends to give the impression that American manufacturing industry is now employing about all of the new knowledge that science has thus far developed, and that it is busily pushing forward in the discovery of "know-how" for the production of better and cheaper products. This impression is fairly accurate insofar as certain types of manufacturing are concerned but decidedly misleading with regard to others. In the primary wood-using industries of the Northeast--sawmills, wood turneries, box and crate mills, cooperage plants, and even wood pulp mills--there are no large business units like those in steel or automobiles or electrical equipment. The prevailing pattern is one of very small enterprises, often individually owned, employing from a half dozen to not more than a few hundred people.

There are about 7,000 of these small primary processing plants and probably about an equal number of establishments that use lumber or some other semi-manufactured form of wood in the fabrication of a final product. With the exception of about a dozen of the largest wood pulp manufacturers, none of these primary processing plants could afford to establish and maintain research laboratories of its own. The majority are located in small towns or in temporary settings in the woods--where it is difficult to obtain technical information and often still more difficult to put it into practice. It is not surprising that the harvesting and primary processing of timber products should so often be done by crude and wasteful methods. The technical handicaps that beset these industries are made more critical by the ever-increasing competition of metals, plastics, glass, brick and concrete, and other materials. It is not at all unusual for firms manufacturing some of these competing products to devote as much as 2 or 3 percent of gross receipts to research in their own laboratories.

The situation just described has been recognized for many years. It has been met in part by the establishment of public or quasi-public research agencies that devote all or a major share of their efforts to the technology of wood utilization. The Forest Service was one of the pioneers in this work when it set up the Forest Products Laboratory--now located at Madison, Wisconsin. The services of this Laboratory were extended still further in 1944 when "Forest Utilization Service" units were established at several of the Forest Experiment Stations. Each unit consists of two or three technically trained men who spend somewhat more than half of their time in the field visiting wood-using plants and logging operations where many of the utilization problems are studied at first hand. Time after time the Forest Utilization Service men are able to give assistance to operators by on-the-spot advice and by supplying some technical bulletin that has been published by the Laboratory or by some other research agency. In other instances they are able to present the problem to the Laboratory's specialists and thus obtain an answer. In still other instances there may be no scientific data on the problem. If it is of substantial importance, the Forest Utilization Service men work out a research project proposal for consideration in the Laboratory's work program.

The 1947 program of the Northeastern Station's Forest Utilization Service included a wide range of activities. The preliminary edition of the Northeastern Loggers' Handbook was completed and released in 18 separate sections. Hundreds of enthusiastic comments have been received from people who are now using the Handbook material. Many have offered helpful criticisms and suggestions. The demand for this preliminary edition has far exceeded expectations. About 8,000 sets of the 18 sections have been distributed in response to requests. Quantity orders for about 4,000 sets had to be turned down because of inability to process that many. Plans for the issuing of a printed edition are now well advanced. About a third of the sections have been used by trade journals as occasional articles. One Canadian journal has started to publish the entire handbook in a continuing series of monthly articles.

In July and August the Forest Utilization Service arranged and conducted three demonstrations of new and improved logging equipment. Two of these (at Donegal, Pennsylvania, and at Sharon, Vermont) were held in cooperation with section meetings of the Society of American Foresters. The third (at Massabesic Experimental Forest near Alfred, Maine) was arranged in cooperation with the Extension Foresters of Maine and New Hampshire. Attendance at the three demonstrations was as follows: Donegal - 250 loggers and 180 professional foresters; Sharon - 150 loggers and 125 foresters; Massabesic - 500 loggers. The equipment demonstrated at these shows included several different makes of chain saws, including some with the new chisel-type teeth and some with the bow-type frame. Four makes of crawler-type tractors--some equipped with rubber tracks and hydraulic drawbars, together with accessory winches, skidding pans, or sulkies were on demonstration. Other equipment included hydraulic and mechanical loading cranes, logging trucks with safety-trip stakes and self-loading devices, a tractor-mounted circular-saw bucking rig, a metal detector for locating nails and similar metal objects imbedded in logs, and a power borer for tapping sugar maple trees. Many requests for repeat demonstrations have been received. The limitation of personnel will, however, make it necessary to attempt not more than three such demonstrations in the coming year.

Another major project in the 1947 Forest Utilization Service program was the two kiln-drying courses that were held in cooperation with the Forest Products Laboratory and with the state universities of Maine and New Hampshire. These intensive 2-week courses are designed for dry-kiln operators and for those responsible for dry-kiln supervision. The course includes lectures, demonstrations, laboratory work, and personal conferences between the instructors and students. A total of 38 men were enrolled in the two courses--quite a few were sent by the companies that employ them. One day of each course was given to a special session for the managers of plants that had men in attendance. This proved to be quite successful--25 plants were represented. The managers thus got some insight regarding the principles and techniques that their kiln operators had been learning. The interest in kiln drying thus stimulated by the courses has found further expression in the organization of the Northeastern Kiln Drying Association. The membership is made up of dry-kiln operators and supervisors who plan to meet occasionally for exchange of

technical information and to share experiences. One of the Forest Utilization Service staff members serves as advisor to this Association.

The demand for kiln-drying information and for trouble-shooting advice on kiln operation problems has been much in evidence. About 300 inquiries on this subject from Northeastern people have been handled by the Laboratory and the Forest Utilization Service. In a few instances it was possible to visit the plant and make a more thorough analysis of the problems. An experimental dry kiln, on loan from the Laboratory to the Forestry Department of the University of Maine, has been in use to develop suitable schedules for drying thick beech turnery stock, and several other specialty items. This work has been done by the University of Maine in accordance with a work plan prepared by the Forest Products Laboratory and the Forest Utilization Service.

An experiment to test the value of a rust-inhibitor salt treatment in reducing defects in air-seasoning thick beech lumber used for wooden bowls was completed. This project was conducted in cooperation with a private manufacturer, the University of Maine, the Laboratory, and the Forest Utilization Service. Encouraging results were obtained. Still another cooperative project with similar participation is designed to test the various methods for piling white birch turnery squares in air-seasoning yards. Preliminary results indicate that this project will yield some valuable information on drying rates for each type of pile.

The Maine forest fire disaster (previously mentioned) resulted in the killing of about 150 million board feet of sawlog timber and about 200 thousand cords of pole timber. The salvage of this fire-killed timber (mostly white pine and northern hardwoods) will have to be accomplished in about a year if heavy losses from insects, windthrow, and decay are to be avoided. The Forest Utilization Service is trying to give assistance in this job. A large number of the sawlog operators in the fire area have been visited in order to help in solution of utilization problems. Sawlog material from the larger properties will apparently move quite readily, but the owners of small tracts and of farm woodlots are probably due to have some trouble in disposing of their burned timber. The outlook for the utilization of the pole timber is much less favorable. There is a very limited market for white pine pulpwood. One sulfate mill is about ready to begin operation but it already has a large supply of wood on contract and on hand. Two other sulfate mills are still in the blue-print stage. Laboratory tests carried out by the mill that is starting showed that wood with charred bark could not be used unless it was peeled at the point of origin. This requirement raises many difficulties that are being studied. The prices now offered make the possibilities of economical operation very doubtful because at least half of the pine pulpwood is charred. The outlook for the utilization of hardwood pulpwood is considerably better. A soda-process mill in the immediate vicinity of the fire area has indicated a willingness to take substantial quantities of uncharred hardwood pulpwood at a favorable price. Only about 10 percent of the hardwood pulpwood has been charred. Further assistance to the Maine timber-salvage program will be given in the coming year.

As the work of the Forest Utilization Service has become more widely known, there has been an increase in invitations to participate in the meetings of technical groups and trade associations. Members of the staff have contributed papers, informal talks or comment in meetings held in 1947 under the following auspices: Appalachian Hardwood Manufacturers' Association, Southern Maryland Lumberman's Association, New England Lumberman's Association, Northeastern Wood Utilization Council, New York Section of the Society of American Foresters, Home and Farm Week of the University of Maine, New York State Department of Commerce "Wood Clinic", University of Massachusetts "Wood Industry School", Southern New England Lumber Products Conference, Vermont Bureau of Industrial Research, Brooklyn Polytechnic Institute, and the Forest Products Research Society. Staff members have also participated in a number of radio broadcasts.

One final indication of the way in which the services of the Forest Products Laboratory and the Forest Utilization Service are being used by the producers and consumers of wood products in the Northeast is the number of persons who travel to Madison for a personal conference with Laboratory personnel. The Laboratory's record of these visitors shows that there were 302 from the Northeast in 1947. The number of letter inquiries handled by the Laboratory and the Station's Forest Utilization Service in 1947 exceeded 2,000.

Plans for 1948

The work of establishing contacts for the Forest Utilization Service in the Northeast has largely been completed. The wood-using industries, equipment manufacturers, trade associations, and the various public and quasi-public research agencies dealing with wood are now familiar with the unit and its services, and are ready and eager to use them. The unit has practically completed problem analyses of several types of wood-using industries, although periodic review will be necessary.

Plans for 1948 are, consequently, to emphasize the development of new knowledge by stimulating existing research agencies to tackle the problems and by participating in such research to the extent possible. With the reactivation of old and establishment of new Research Centers of the Station the opportunity exists to break new ground in the timber-harvesting field. Several studies of new methods of harvesting are planned at these centers. Studies important to the Northeast have also been started or planned at the Forest Products Laboratory. Other agencies, including state forest schools, agricultural engineering departments, and industrial research laboratories are interested in this field, and will be offered assistance in their activities.

The same situation exists in other fields in which the Forest Utilization Service has been working. Several major problems of wood use in the Northeast such as pulping hardwoods, log grading, and processing methods are under investigation at Madison, some of them cooperative projects partially supported by northeastern industries. Cooperative studies have also been started with a number of outside agencies. Among them are studies in sawmill development, wood preservation, manufacturing coarse fiber products, seasoning,

machining, and nutritional tests of wood molasses. Other cooperative projects are in the blueprint stage.

Dissemination of existing knowledge to industry will, of course, be continued. It is hoped that it will be possible more and more to do this through extension and service agencies on a wholesale, rather than a retail basis. Three kiln-drying demonstrations are planned to be followed by formation of three kiln-drying associations in the Station territory. This is another step in supplying information on a wholesale basis. Some interest is also developing in the formation of a logging congress or institute.

Publications planned for 1948 include a series of two or three Station papers, supplementing the Northeastern Loggers' Handbook, on supervisory aspects of logging. The woods-workers' portion of the Handbook has been accepted for publication as a Miscellaneous Bulletin of the Department, to be sold by the Superintendent of Documents at something less than $1 a copy. Demand for this publication is heavy, and any work necessary to expedite its publication will be given high priority. The manuscript for the proposed Farmers' Bulletin on "Harvesting Woodland Crops in the Northeast" will be reviewed by the 15-man coordinating committee, consisting largely of Extension Foresters, and following receipt of their comments will be put in shape for publication. The Extension Foresters have asked that 75,000 copies be printed for distribution by them, in addition to whatever distribution the Forest Service and State Foresters wish to make.

Other publications planned as Station notes or papers or as trade journal articles include: Highlights of laminating, front-line developments in wood treatment research, wood byproducts from mill wastes, costs of poor kiln drying, and one on strength of various species for mine timbers. We hope work may be started on compiling information on the use of beech, a species that is not readily marketable in many northeastern woodlands.

COOPERATIVE FARM FORESTRY RESEARCH

A Norris-Doxey cooperative farm forestry research project is being conducted in Connecticut in cooperation with the State Department of Forestry, the Connecticut Agricultural Experiment Station, and the Connecticut Forest and Park Association. The cooperating agencies have been interested in studies (1) to improve utilization and harvesting methods, (2) to point out the importance of well-managed farm woodlands to the farmer and the community, and (3) to improve silvicultural and management practices.

Most of the research accomplished under this project during the past year is in the field of utilization and harvesting. One study reported in "Connecticut Woodlands", published by the Forest and Park Association, attempted to determine the minimum size chain-saw crew that is most efficient in cutting white pine logs. It was found that a 5-man crew operating a chain saw with a 3-foot blade resulted in maximum use of the saw and greater production of sawlog volume. The usual practice in farm woodlands such as we find in Connecticut has been to use a 2- or 3-man crew with the chain saw. Part of the time the saw is idle while the men are limbing, swamping, and marking the logs. In a 5-man crew two men are swamping and limbing while the other three are alternating at handling the saw, notching, and bucking.

Methods of utilization stressed during the past year have been to obtain more accurate information on the actual cubic-foot volume per measured cord of pulpwood.

Connecticut uses a considerable quantity of charcoal in curing tobacco and in purifying molten metal material. A survey of the volume of charcoal required and costs of making charcoal out of low-quality woods has been initiated. Because of the large quantities of low-quality hardwoods--principally oak--in Connecticut, the charcoal market is believed to provide one of the best ways of converting timber unmerchantable for higher-quality products into a satisfactory income for the small landowners.

There is a growing demand in Connecticut for preservative-treated tobacco poles, fence posts, and highway posts. Methods of treatment and preservative materials are being investigated in cooperation with the Connecticut Agricultural Experiment Station at five small pole-treating plants.

During the program-planning conference with the cooperators and foresters in Connecticut, the problem of demo nstrating or finding actual examples of well-managed woodlands was discussed. The farm woodland owner has been paying less attention to his timber and devoting greater effort to types of work that yielded greater income. Consequently the woodlands are being neglected. One of the principal projects that practically everyone agreed was of first priority is to demonstrate the importance of managed woodlands by making a comparison of the returns to a timber owner when

he sells stumpage, makes a lump-sum sale of an undetermined volume of timber, or does his own cutting and marketing.

An additional effort to demonstrate the value of farm woodlands through the growing of Christmas trees is under way. Connecticut is in the heart of the largest industrial area in the world. Markets for Christmas trees and other woodland products exist throughout the State.

Plans for 1948

Plans for 1948 place special emphasis on improving methods of treating tobacco poles, and on the use of pentachlorophenol for treating highway posts of native species. Since bark removal is a necessary requirement when oil-soluble preservatives are used, further work on developing a successful powered post-peeler is also scheduled.

An intensive study of a heavy thinning in a medium-age red pine plantation will be begun. There are an estimated 20,000 acres of this species planted in Connecticut and more data should be gathered on the potentialities of such plantings.

Vigorous action is being taken by agencies in the State to induce the establishment of a pulp mill in Connecticut. This would provide a partial outlet for the large amount of low-grade unmarketable material now representing much of the volume of the wooded areas of that State. In anticipation of this, studies are being planned to obtain information on proper cutting practices and harvesting methods. One phase of this study will include the possibilities of bundling pulpwood by steel strapping to facilitate handling. An improved method of handling fuelwood by packaging in small bundles with steel strapping is now being tried out by a private cooperator.

Some attention will be given to the possibilities of cooperative ownership of logging and milling equipment. Such work would be carried out in part in Rhode Island where a light portable mill is already in operation through the sponsorship of local soil conservation districts. Also a study may be initiated on the use of portable chippers for supplying wood chips to be used as a soil conditioner.

FOREST ECONOMICS STUDIES

The chief efforts of the economics unit in the early part of the year were devoted to a winding up of the Station's studies and responsibilities connected with the Otsego Forest Products Association at Cooperstown, New York.

On May 26, papers which settled the debt obligation of the Association to the Federal Government were signed. The final settlement involved a cash payment of $70,000. The Cooperative then entered upon a new life of full financial independence with a realistic capital structure. Continuing favorable lumber prices have now placed the Cooperative in a favorable financial position. The first dividend on capital stock was declared on October 1. New efforts are being made to extend the services to members and to strengthen the forestry program. A policy of building strength for eventual hard times has been adopted. The general outlook for success was never so favorable.

Studies brought to completion included an analysis of lumber yield from graded logs. The Association has been buying logs on the Forest Products Laboratory hardwood log grades system for some 10 years. A mill study, based on 170,000 board feet of mixed hardwood logs, showed excellent correlation between log grade and lumber value therefrom. This study is due for publication as a Station Paper.[4/] Other studies now in the office report stage include: an opinion survey made to determine what the members knew about and thought about the Otsego Forest Products Cooperative Association; a statistical analysis of the returns to members of the Association for logs that they have delivered to it during the period 1938-46 (This is broken down to show the net return on stumpage and the earnings by members who did part or all of their own logging); a revised version of the Station Paper on the rapid cruise system developed for use on small woodland acreages at Cooperstown has been prepared for republication.

A work plan for checking the quality of recent cutting on member woodlots and appraising the existing forest condition has been prepared.[5/]

Preliminary work on the preparation of an over-all report on the 10 years of experience with the Otsego Forest Products Cooperative has begun. This report will summarize what has been learned about the possibilities for improved management and utilization of small woodlands through the Cooperstown type of forest cooperative. It will contain the findings of all the hitherto unreported studies, including those now in office report form.

4/ Published in May 1948.
5/ Check has been completed and office report prepared, June 1948.

Considerable time was devoted to exploratory work in preparation for a new project in farm forest products marketing research. Consultation and advice have been contributed to a forest insurance research project carried on under a grant by the Insurance Institute of America at the University of Pennsylvania's Wharton School of Finance. An office report on this project is nearing completion.6/ Similar consultation and advice has been given on the subject of forest taxation to State officials in New York, Maine, and West Virginia.

A comprehensive problem analysis of the field of economics of forestry in the Northeastern States has been initiated. Work so far has been limited to exploratory discussions and to an analysis of the sources of fibrous material consumed by the Northeastern paper-making industry in 1946.

Plans for next year include the completion of the over-all report on the experience with the Otsego Forest Products Cooperative Association; initiation of a project in the field of marketing farm forest products; continued assistance to State Foresters on special projects such as taxation, and problem area studies 7/; continued cooperation with other agencies interested in the economics of forestry.8/

6/ Completed early in 1948.

7/ The study of the fire-damaged area of York and Oxford Counties in Maine is now (August 1948) under active consideration.

8/ Arrangements for a cooperative study of small woodland ownership have now (August 1948) been completed with Harvard University and the Federal Reserve Bank of Boston as the Station's cooperating agencies.

FOREST MANAGEMENT RESEARCH

DEVELOPMENTS IN SPRUCE BUDWORM RESEARCH

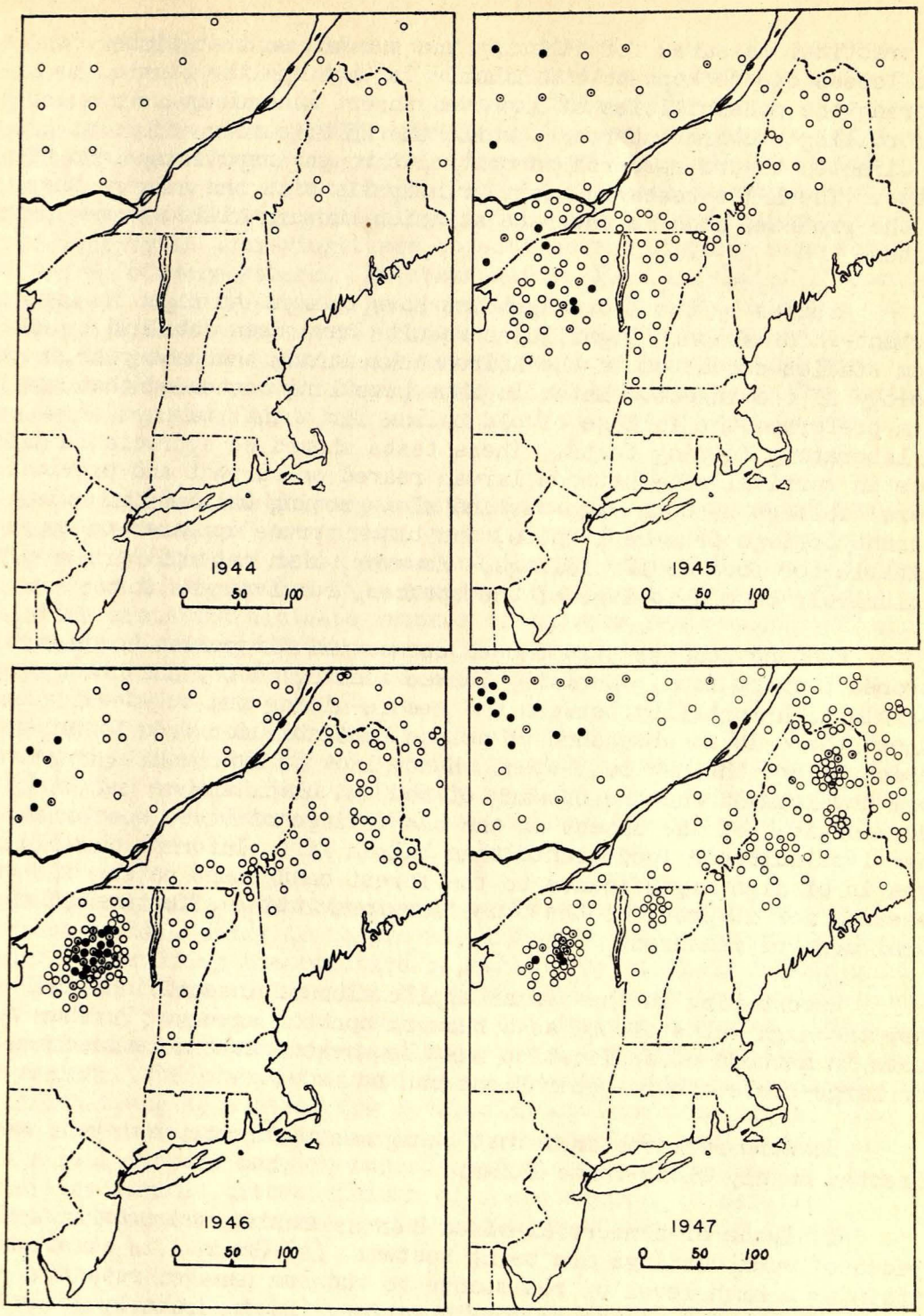
Significant events both favorable and unfavorable developed in the northeastern spruce budworm epidemic during 1947. On the bright side of the picture is the tremendous decline in the intensity of the outbreak in the Adirondacks. In 1945 several thousand square miles of this region suddenly became infested by the budworm. Populations as high as several hundred caterpillars per tree were noted. The following year saw a marked increase; entomologists estimated an increase of perhaps tenfold.

Then, in 1947, there was a marked decrease. Why this sudden decline in intensity of attack in 1947? Parasites for one thing, say the entomologists. Aggregate parasitization by insect enemies in 1946 and 1947 ranged from 50 to 80 percent. Entomologists also point to insectivorous birds as having been effective in reducing larvae population in the Adirondacks section. Then there is the character of the Adirondack forests to be considered. Their diversified nature and the absence of great expanses of spruce-fir growth undoubtedly contributed to natural control of the insect. Another encouraging feature in the over-all picture is the continued low population level of the insect in Vermont and New Hampshire.

But budworm surveys conducted by the Bureau of Entomology and Plant Quarantine show that unfavorable factors are operating as well. Like a military staff pin-pointing enemy advances along a battle front, the Bureau in cooperation with state detection agencies has been tracing the progress of the epidemic since it first assumed threatening proportions. These surveys over the past 4 years (fig. 5) show a slow but steady increase in budworm population in Maine. This State, it should be borne in mind, contains nearly two-thirds of the Northeast's spruce-fir producing lands. Although not yet appearing in numbers approaching an epidemic, evidence of budworm feeding is on the increase. The heaviest concentrations are in the towns west and northwest of Moosehead Lake to the Canadian border; around Mt. Chase; and in the townships lying between Portage and Eagle Lake. Moreover the percentage of parasitism in the collections thus far made is low. It may be premature to predict what may happen in Maine in 1948 but the situation certainly bears close watching.

Budworm research in its various phases during the past year continued according to plan. The three principal Federal agencies engaged in the project, namely the Forest Service, the BE&PQ and the Bureau of Plant Industry, under a coordinated plan and in cooperation with states and private industry, are all aiming at a common goal: the development

Figure 5



SPRUCE BUDWORM
DEVELOPMENT OF INFESTATION 1944 —— 1947

○ LIGHT ◉ MEDIUM ● HEAVY

of practical measures for fighting the budworm so that timber damage and losses can be kept to a minimum. To that end the Station is exploring the possibilities of improved forest management as a means of controlling budworm outbreaks, while the BE&PQ's main effort at present is directed toward research on control through insecticides and parasites. The BPI's research deals principally with the salvage phases of the problem, such as the rate at which budworm-killed timber deteriorates.

Studies by the above agencies have brought to light new and important information. Significant results have been obtained by BE&PQ from studies conducted in the Adirondacks during the past year on the biology of the insect. Entomologists have long contended that the budworm preferred the foliage of old balsam fir. This was not borne out by laboratory feeding tests. These tests showed no appreciable difference in survival rate between larvae reared on current and previous years' foliage of both vigorous and slow-growing balsam fir. Also, current foliage from red, white, and black spruce appeared to be as suitable for food as fir foliage. However, when caterpillars were fed exclusively on old foliage of the spruces, survival was low.

Feeding studies also showed spruce and fir pollen to be a highly favored budworm food. Normally larvae feeding on red and black spruce sustain high mortality between the needle-mining and bud-feeding stages unless there is an abundance of pollen available for food to bridge the period before the new buds open. Hence lack of synchronism between budworm development and the opening of red and black spruce buds and the poor survival of the insect on the old foliage of these species make them less suitable food plants than balsam fir. Information of this type is of high significance to the forest management phases of budworm research for it provides the clues for formulating effective silvicultural control measures.

Recent work in the aerial application of insecticides indicates anew the high value of DDT as a budworm control agency. Further refinements in methods of application must be worked out before recommendations for large-scale control operations can be made.

Budworm research in forest management over the past year was directed mainly along three lines:

1. Tests of commercial-sized budworm resistance cuttings. Three grades of such cuttings are being tested: (A) Grade A is aimed at attaining a high level of resistance to budworm damage; retention of growing stock is a secondary consideration; (B) in Grade B, goals of budworm resistance and retention of satisfactory growing stock are on a parity; (C) In Grade C, retention of desirable amount of growing stock outweighs attainment of high resistance level.

These cuttings strive for resistance by increasing the proportion of spruce and maintaining a high level of stand vigor. But will so-called

resistance cuttings achieve these two objectives? There are reasons for believing so; but they need to be substantiated. Budworm research must solve such questions as how to convert balsam fir-spruce stands to stands containing a higher proportion of spruce, and how to produce and maintain vigorous growing stock. These are basic silvicultural questions involving regeneration studies and cultural measures, such as weedings, release cuttings, thinnings, etc., and the determination of their efficiency in achieving these objectives and staging successful recovery from budworm attack. In other words, full knowledge of spruce-fir management techniques is a prerequisite to successful budworm control through forest management. Further, we need to determine the extent to which desirable management techniques are feasible and the modifications needed to make them practical of application. The cutting areas are so organized that they will contribute materially to these questions.

Six additional cutting areas established in the course of the year bring the total of such areas, which range up to 800 acres, to 15. The distribution of these areas and those proposed for establishment are shown in figure 6. Time studies as a basis for determining the relative costs and ultimate returns of budworm resistance cuttings against the usual heavy cuttings are also being conducted on these areas. Cost data are now in the process of being analyzed.

2. Tests of the vulnerability formula developed by the Station for rating the vulnerability of spruce-fir stands. Recent work in this field indicates reasonably satisfactory results. The formula has been used extensively. However, the need for further testing of the formula is indicated.

3. Development of techniques for rapid budworm-hazard mapping. The purpose of this study is to provide industry with a practical tool for rapidly appraising the relative vulnerability of their holdings to budworm attack. This will enable the timberland owner to develop sound, orderly cutting programs. Two years ago the Station undertook the preparation of detailed budworm-hazard maps for a few critical townships in the region. The scheme followed is to vary the approach and methods in different towns as a basis for developing optimum techniques. The work over the past year indicates that where complete cruise data are available satisfactory budworm-hazard maps can be made by use of the vulnerability formula with a minimum of field checks. A detailed statement of procedure for use by interested land owners is in preparation.

Considerable progress was made this year toward the completion of statewide vulnerability maps. The map for Maine was completed insofar as available data permits and is now being distributed to interested timberland owners and forestry agencies. A similar map is nearing completion for New Hampshire and progress maps for Vermont and New York are in preparation.

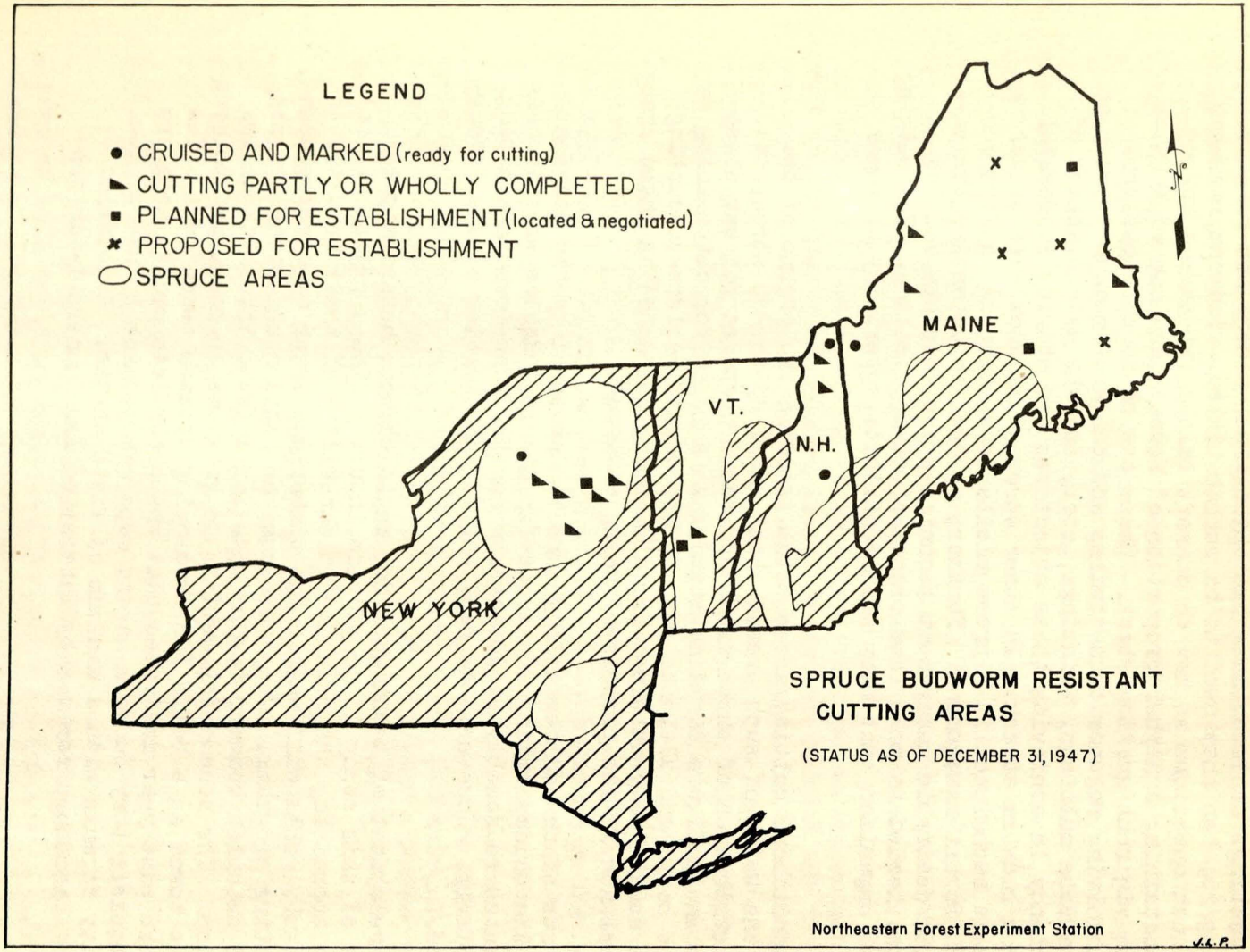


Figure 6.--Areas have been established to test cutting experiments designed to increase resistance to the spruce budworm.

An illustrated pamphlet entitled "The Budworm is Back", calling attention to the budworm menace and suggesting silvicultural measures for its control, was published in cooperation with the Society for the Protection of New Hampshire Forests. This booklet was well received and got wide distribution.

The Bureau of Plant Industry only recently initiated studies in the deterioration of budworm-killed timber. The work is being done in budworm-killed timber areas in the Nipigon Lake region of Canada where all stages of decay following budworm attack are available for study. Dependable information on this question is important to timberland owners from the standpoint of estimating the probable period for salvaging operations.

Plans for 1948

No major changes in the conduct of the budworm research program are contemplated for 1948. Efforts will be made to complete the establishment of cutting areas as soon as possible so that more time can be devoted to the broader fields of spruce-fir management needed not only to solve the budworm problem but overcome other obstacles hindering profitable forestry practices in the spruce-fir region.

The thrust of the budworm front deep into the Adirondack territory in 1945 focused the attention of budworm research agencies the following 2 years to this sector. However, with the rapid decline of the Adirondack infestation in 1947 and the apparent rapid buildup of budworm populations in Maine, it is planned to give increased emphasis to the work there already under way. The Forest Insects Investigations Division of BE&PQ has similar plans. Hence there will be no interruption in the effective unified budworm research developed between this agency and the Station.

SILVICULTURE

Harvest Cuttings

Spruce-fir

A "vulnerability rating" for individual trees, based upon general vigor, crown class, and crown ratio was developed and tested. This rating is on the basis of 10 being most resistant and is obtained by adding ratings for the several elements. It facilitates the marking of stands to increase resistance to budworm attack.

A method of rating stands as to apparent vulnerability to budworm attack was likewise developed. It is derived by multiplying the volume of fir per acre (in cords) by the basal area of the average-sized fir (in square inches). Vulnerability so rated is expected to be as follows:

No hazard	0 to 20
Light hazard	21 to 100
Medium hazard	101 to 250
High hazard	251 and higher

Experimental cuttings designed to reduce hazard of budworm attack were reflected in materially reduced ratings under the method. It has proven useful also in preparing "vulnerability maps" of extensive properties as a guide to harvest cuttings.

Cutting was partially or wholly completed on 11 of 22 areas marked for commercial operation to reduce susceptibility of the stands to budworm attack. Four of these were in Maine, three in the territory of the Winnepesaukee Branch, and four in the Adirondacks. All the treated areas received a preliminary cruise and were marked for cutting; and on those where cutting was completed semi-permanent cruise plots were located after cutting.

In a study of the time consumed in experimentally marking six typical stands for budworm resistance cuttings it was found that on an average one man could mark 6-1/4 acres per day, or about 50 cords per day, on areas that were to receive a 40-60 percent cut. At an average daily wage of $10.00 plus 2 cents per cord for marking paint, the total cost per cord would be $0.20. On a large scale commercial job where there is less need for extreme accuracy than on these experimental areas, at least 70 cords per man-day could be marked at about $0.15 per cord. This represents less than 1 percent of the average cost of company-operated wood delivered at the mill.

In Maine the cost of felling, limbing, and bucking on areas partially cut to increase resistance to budworm attack was found to be no higher than on an adjacent area being clear-cut. On the basis of curve values derived from timing the operations on 432 trees of spruce and fir it appears that less time was required under partial cutting to work up 10 inch and larger trees. The reliability of the values in table 1 has not been checked statistically, yet it is obvious that partial cutting is unlikely to prove a handicap in converting trees to pulpwood.

A pair of plots established 8 years ago at Gale River were remeasured and showed that the growth on the one from which 54 percent of the merchantable volume had been removed in a partial cutting was 109 cubic feet per acre per year. The uncut check plot had grown slightly less than 1/3 cord per acre per year, or about what yield tables predict for good average stands.

White Pine

Previous plans for studies of harvest cuttings in the white pine type on the Massabesic Experimental Forest were completely disrupted by the disastrous fire in October. Some 3,200 acres of the

3,700 in the experimental forest were burned over with greater or lesser severity. Salvage cutting of some 4,800,000 feet of damaged timber was begun in December after the forest was remapped according to degree of burn, type and size of timber, and the amount and priority of salvageable material.

Table 1.--Time required to convert standing spruce and fir trees to pulpwood, by diameter class and kind of cutting[1/]

D.b.h. class (inches)	Partial cutting	Clear-cutting
	Man-minutes	Man-minutes
6	5.0	5.5
7	7.5	7.0
8	10.0	9.5
9	12.5	12.5
10	15.5	16.5
11	19.0	21.5
12	23.0	26.5
13	27.5	31.5
14	32.0	37.0
15	37.5	42.0
16	44.0	48.0
17	51.5	--
18	59.5	--
19	68.0	--
20	77.0	--

1/ Stacking time not included.

Allegheny Hardwoods

The 20-year remeasurement was made of four methods of cutting plots established in 1927 in a 60-year old stand in the beech-birch-maple-hemlock type on the Allegheny National Forest. The data were in process of analysis at the end of the year. Despite serious

interference by oil-well development on the untreated plot, the 1947 d.b.h. of the cut trees was reconstructed from stump measurements.

Coastal Oak-Pine

Seven years after clear-cutting that left 10 well distributed pine seed trees per acre, the plot on which the slash was burned and the soil torn up with a ripper had the highest number of pine seedlings per acre (3,316); whereas the area on which the slash was lopped and scattered only had but 937 pine seedlings per acre (table 2). In an untreated portion of the original stand only 566 pine seedlings per acre were found. The mechanical treatments, ripping, and disking, cost $15 to $20 per acre.

Table 2.--Effect of mechanical seedbed preparation on pine reproduction (7 years after treatment)

Treatment	Pine reproduction per acre		Average height of tallest pines
	Seedlings	Sprouts	
	Number	Number	Feet
Slash burned and area ripped	3316	79	6.4
Slash burned and area disked	2146	112	6.6
Slash burned and area untreated	1800	141	7.3
Slash lopped and scattered, area untreated	937	204	7.4
No treatment and stand uncut	566	67	1.3

Plans for 1948

Major activity at the research centers having management experimental forests will be directed toward initiating the harvest cutting programs. On the Beltsville, Hopkins Memorial, Wayne County (Pa.), and

Paul Smith and Massabesic there still remains a considerable job of examining the forest, subdividing it, planning the management systems to be followed, and assigning them to specific areas. First cuttings are expected, however, on several of the forests.

Special effort will be made to initiate work on the Bartlett Experimental Forest and related stands in the northern hardwood forest type.

Intermediate Harvest Cuttings

Anthracite Region Hardwoods

Nearly 80 percent of the Anthracite Region's forest land consists of seedling and sapling stands of poor form, quality, and composition. These are normally clear-cut for mine props, lagging, and forepoles, although what the stands really need is thinning and weeding. According to preliminary results they can be thinned for lagging and small props at a profit.

Under a cooperative agreement with the Lehigh Coal and Navigation Company a block of four contiguous 5-acre areas in a 30-year-old oak stand was cut. Three areas were partially cut, removing 22, 40, and 65 percent of the volume respectively. The fourth was clear-cut for lagging, forepoles, and small props in accordance with local practice. The partial cuttings were largely in the nature of thinning and weeding. The effectiveness of the partial cuts in stimulating growth and improving stand quality will be determined from sample plots established in each area.

Table 3 shows that normal wages can be made by a 40 percent cut and a fair profit by a 65 percent cut. Probably a 50 percent cut would give the landowner a fair stumpage rate and the operator a small profit in addition to wages if he did the work himself. The stand would be greatly improved and could be thinned again at a greater profit in 10 to 15 years.

Plans for 1948

No specific new studies are scheduled for the year, although the experimental forests being developed for management studies may present opportunities for such work.

Plots on the Kane Experimental Forest thinned for pulpwood in 1933 will be reexamined.

Table 3.--Preliminary results from intermediate harvest cuttings

(Basis: 1 acre)

Block	Volume[1]		Volume cut		Gross return	Costs[2]	Return	Stumpage[3]	Computed net return
	Before cut	After cut							
	Cubic feet	Cubic feet	Percent	Tons					
1	613	213	65	11	$58.95	$49.85	$ 9.10	$.56	$ 5.89
2	702	46	93	21	112.44	99.74	12.69	.35	11.24
3	722	431	40	8	40.22	41.30	-1.08	.16	(4/)
4	769	597	22	5	25.94	27.64	-1.70	0	-.30

1/ Includes trees 2.1 inches d.b.h. and over.

2/ Includes stumpage @ $0.28 per ton; labor @ $.75 per hr. (2 men); supervision @ $1.00 per hr. (2 men); with gas, oil, etc. $10.00; social security insurance, unemployment compensation $18.24, prorated by tons cut and man-hours worked respectively.

3/ Computed stumpage = (selling price - 10 percent for profit and risk) - operating costs.

4/ Wages; no profit.

Stand Improvement

Coastal Oak-Pine

Analysis of the results of 10 years of prescribed burning at the Lebanon Experimental Forest in New Jersey indicate that it is a promising method of controlling the composition of the oak-pine type on deep sandy soils of the coastal plain.

As might be expected, the areas control-burned at 5-year intervals, with the last burn in 1941-42, had only a slight increase between 1946 and 1947 as the effects of the last burn on the seedbed had been largely lost.

The periodic use of controlled burning appears helpful in perpetuating pine stands. If controlled burns are not used until a pine stand is mature, an advanced growth of hardwoods in the understory will probably increase the difficulty of establishing another pure pine stand. If they are started when the stand is about 15 to 20 years old the seedbed will be kept in an unsatisfactory condition for hardwood establishment and the burns will kill many of those already present. At that age these hardwoods would usually be less than 2 feet tall.

Table 4.--Effect of controlled burning at different intervals on reproduction of pine seedlings 1/

Burning intervals (Years)	Burns	Last burn	Pine seedings per acre 2/		
			Before burning	Summer of 1946	Summer of 1947
	Number	Date	Number	Number	Number
1	10	1945-46	700	1,200	1,720
2	5	1944-45	710	2,110	2,340
3	4	1945-46	290	790	1,110
4	3	1944-45	430	990	1,530
5	2	1941-42	160	780	810
10	1	1936-37	460	790	740
15	1	1936-37	380	1,250	1,120
Unburned controls	0	-	290	430	290

1/ First burns of all treated plots made winter of 1936-37. None made after winter of 1945-46. All oaks cut winter of 1946-47.

2/ Mostly pitch and shortleaf, but including an occasional Virginia pine.

It is also more desirable than mechanical preparation of the seedbed because it keeps the fire hazard low. Controlled burns vary in cost from about $0.03 per acre to $1.40 per acre for each burn. Some of the factors affecting costs are (1) insufficient fuel so that fire does not spread, (2) need for fire line preparation, (3) need for excessive amount of firing on irregularly shaped areas, (4) improper conditions for burning, and (5) size of area to be burned. The influence of these factors on cost is shown in table 6.

Allegheny Hardwoods

Mowing off advance regeneration at the time a salvage cutting of overmature timber was made on the Kane Experimental Forest in 1937 did not result in more or better reproduction. The destruction of the advance growth permitted invasion of blackberry, devils-club, pin cherry, and other intolerant species and to the production of a high proportion of multiple-sprout clumps. The unmowed portion of the 15-acre tract cutover had ample reproduction at the end of 5 years after cutting due to negligible losses in the advance growth and the increase in number of new stems after cutting.

Table 5.--Effect of three controlled burns on hardwood advance growth

Size of hardwoods before burn[1]	Seedlings and sprout clumps per acre before first burn	After 3 controlled burns, original stems--		
		Still alive	Killed but sprouting	Killed, no sprouts
	Number	Percent	Percent	Percent
0 - 1.5' tall	443	0	67	33
1.6'- 3.5' tall	511	0	91	9
3.6' tall to 0.5" d.b.h.	421	11	81	8
0.6" - 1.5" d.b.h.	398	86	14	0
Over 1.5" d.b.h.	68	100	0	0
All size classes	1,841	25	63	12

1/ Tallest member of sprout clump indicates size class. Species primarily black oak, white oak, post oak, hickory, walnut, red maple, and holly.

Piedmont Oak-Pine

Prescribed burning for hazard reduction and control of hardwood sprouts on a 5-year-old burn on the Beltsville Experimental Forest failed in both objectives. The fire was set after 4:00 p.m. on March 20, which rated a class 3 (moderate danger) day. The fire spread satisfactorily through grass, weeds, and briars but did not consume heavier fuels. Nor was an appreciable amount of sprout growth killed.

Plans for 1948

Prescribed burning tests will be continued in the coastal oak-pine type and will be expanded slightly to include some work in the scrub oak type of the coastal plain.

MANAGEMENT

The end objective of research in silviculture, utilization, protection, and related fields is the integration of the knowledge gained into patterns of successful forest and land management. For the 72 million acres of forest land in the Northeast the patterns will range widely

Table 6.--Cost of controlled burning related to type and size of area

Type of area	Total acres	Acres burned per man-hour	Cost per acre 1/	Range in cost per acre
Around buildings control-burned for 10 years	10	0.74	$1.35	$1.30-1.40
Safety strips 25-200 feet wide burned annually or biennially for 10 years	138	1.1	0.94	0.70-1.33
Tracts 23-71 acres burned annually for 6-10 years	262	2.9	0.34	0.21-0.78
Tracts 52-133 acres burned biennially for 6 years	185	6.6	0.15	0.12-0.17
Tracts 22-80 acres control-burned for first time	220	5.2	0.19	0.14-0.27

1/ Based on $1.00 per man-hour.

in accordance with the requirements of the species, climate, markets, ownership objectives and desires, present condition of the forest, and other more or less controlling elements.

Much has been learned from observational and sample-plot studies in the past and from them patterns of management are apparent for some types. Yet such synthesized proposals, understandable, are accepted reluctantly or not at all by the great body of landowners, largely because of the lack of data resulting from actual trial on specific pieces of property. In other words, landowners "want to be shown."

In order to provide for comprehensive comparisons of the effectiveness and value of over-all management methods and their relative profitability, some effort in 1947 was directed toward the acquisition

of experimental forests in types not now represented among those the Station has. One, inactive during the war, was reopened; and several others were being organized for research in management.

The Penobscot and Adirondack Research Centers, with the aid of interested outside agencies, investigated several areas as possible locations for expansion and conversion of the budworm research to the broader field of continuous management.

In the Anthracite Region negotiations were completed for the long-term lease of a 2,000-acre tract in Wayne County, Pa., from the Monroe Water Supply Company.

The Hopkins Memorial Experimental Forest in Massachusetts was reopened and the job of subdividing it into compartments was begun. Some progress was made on the Beltsville Experimental Forest, also toward its subdivision.

These, and other experimental forests to be established later, will be the proving grounds on which management methods, systems, and patterns will be tested and evaluated. Records of the cost of various operations on a commercial scale will be weighed against returns, from whatever viewpoints are controlling in the research center territory. Evaluation in terms of growth and quality of timber will be common to all centers; while at some centers watershed, recreational, or other values may equal or exceed in importance purely financial measures of success.

The Station is thus embarking upon the next logical step beyond the sample-plot stage of research, productive though that has been in the past.

MENSURATION

Stand Studies

Allegheny Hardwoods

To provide growth information for use in managing the Kane Experimental Forest and on the forest survey, 238 cruise plots 1/10 acre in size were remeasured on the forest. These plots had been measured previously in 1932 and 1942. They thus provide a record of 15 years' growth on about 900 acres.

The re-inventory cruise data will be analyzed on the tabulating machines in the forest survey office to provide data on the species, size, class, basal area, and cubic-foot volume distribution of stands in various units as of 1947. In addition data on the vigor and quality of each tree from these 1947 tallies will also be tabulated to show the volumes

of good and poor-risk trees available for treatment by stand-improvement or harvest cuttings on a pilot-plant basis.

Plans for 1948

Punch-card analysis of the cruise plot data will be completed.

Tree Studies

Anthracite Region Hardwoods

A supplement to the Station's Forest Management Paper No. 3, "Site Class Volume Tables for the Anthracite Region", was prepared. Utilization in this region commonly extends down to trees as small as 2 inches d.b.h. for mine timbers such as lagging, props, and forepoles. Moreover, many transactions are on the basis of weight rather than some volume unit. Table 7 permits the estimation of products in cubic feet or weight.

Plans for 1948

No additional field work on volume tables has been planned for next year.

FOREST REGENERATION

Planting

Requests from landowners for advice on forest planting during recent years have shown the need for better information on the subject than was available in bulletin form. With some 4,000,000 acres in the Northeast in need of planting, such requests stem from a real forest problem and deserve an adequate response in usable information.

The latest planting bulletins issued by the Federal Government came out in the early 1920's; these are now out of print and somewhat out of date. To meet the present demand for planting information in more specific terms than was possible with the old-type general bulletins, preparation of a series of regional Farmers' Bulletins has been projected in which the Northeast and Lake States will be treated together. The manuscript for a planting bulletin covering this 14-state territory (Minnesota to Maine, south through Maryland), prepared jointly by members of the Northeastern and Lake States Stations, soon will be ready for final review and printing. The bulletin will discuss in some detail choice of species in relation to site, how to plant and establish a forest plantation , how to care for and protect the plantation, and the special problems and methods involved in growing Christmas trees and shelterbelts.

Table 7.--Average cubic-foot volume, weight, and pieces per ton of wood used in anthracite mines

(For timber grown on site II)

6-FOOT LAGGING AND 6-FOOT MINE PROPS[1/]

Mid-diameter (Inches, o.b.)	White oak			Red oak			Red maple			Sassafras		
	Cubic feet	Pounds	Pieces per ton	Cubic feet	Pounds	Pieces per ton	Cubic feet	Pounds	Pieces per ton	Cubic feet	Pounds	Pieces per ton
2	0.14	8	250	0.14	9	222	0.14	8	250	0.14	5	400
3	.30	16	125	.29	19	105	.29	16	125	.31	12	167
4	.55	31	64	.54	34	58	.52	29	68	.56	23	87
5	.87	52	38	.87	55	36	.85	45	44	.88	39	51
6	1.29	77	26	1.25	78	25	--	--	--	--	--	--
7	1.79	108	18	1.65	103	19	--	--	--	--	--	--
8	2.39	145	13	2.08	130	15	--	--	--	--	--	--
12-FOOT FOREPOLES												
3	0.75	40	50	0.73	45	44	0.63	36	55	--	--	--
4	1.20	66	30	1.10	70	28	1.07	60	33	--	--	--
5	1.98	114	17	1.74	112	17	1.70	98	20	--	--	--
6	3.15	180	11	2.64	168	11	--	--	--	--	--	--

1/ Lagging is 6-8 feet long, 2-4 inches at small end. Props are 4½-9 feet long, 6-20 inches diameter at small end. Forepoles are 10-12 feet long, 3 inches at small end.

Allegheny Hardwoods

Four herbicides were tested on milacre quadrats in heavy cover of bracken, goldenrod, blackberry, bush honeysuckle, and miscellaneous weeds and grasses. Of the four, Ammate (Ammonium sulfamate) in concentrations of 218 and 435 pounds per acre was the only one effective. It gave a complete kill, whereas common salt, 2-4-D (2-4-dichlorophenoxy-acetic acid), and G-652 caused only slight browning with some killing of foliage and small plants.

Anthracite Region Hardwoods

One segment of the planting problem in the Northeast is concerned with the conversion of land now occupied by scrub oak. The species now present are not arborescent, leaving no hope of future productivity for the areas unless replaced.

In cooperation with the Lehigh Valley Flood Control Council and the Pennsylvania Department of Forests and Waters, a comprehensive attack was launched on the problem. The experiment will test the effectiveness of three methods of mechanical or hand site preparation, fire, two post-planting release treatments, the addition of fertilizer, size and age of planting stock, and the adaptability of nine species. Later studies will investigate direct seeding and methods of encouraging natural regeneration.

During the past year three block replications of the experiment were prepared for planting in the spring of 1948.

Throughout the mining region mine culm and spoil banks have been a serious source of silt and acid that pollutes streams. Interest in methods of planting the banks is widespread, not only within the Northeast but in other regions as well. A committee of the Anthracite Branch's advisory committee was therefore appointed to assist in planning a program of studies on the problem and to try to coordinate the efforts of the several organizations interested.

Piedmont Oak-Pine

After repeated failures in previous years progress was made toward reforesting a particularly refractory area on the Beltsville Experimental Forest. This area resulted from abandonment of a partially constructed airstrip. It presented a completely bare and sterile expanse of subsoil cut and fill, perhaps worse than is likely to be encountered in any eroded area. Grass, and even the hardiest weeds, failed to become established naturally. Preliminary treatments with mulch were unsuccessful as preparation for tree planting; so part of the denuded area was fertilized and sown to winter rye in 1945. Other parts were sown to lespedeza, grass, and sweet clover in the spring of 1946. After further fertilization in the winter of 1946-47 a satisfactory ground cover developed. Late in 1947 the area was again fertilized and sown to Italian

rye grass and sweet clover. It appears now that it may be grazed for several years while organic matter content of the soil is being built up, after which trees may be feasible to establish tree growth. Costly and difficult though this job has been, it demonstrates the lengths to which it may be necessary to go where high watershed values demand cure of an extremely bad situation.

Atlantic Whitecedar

Small exploratory plantations of Atlantic whitecedar were established on abandoned wet farmland in Southern New Jersey. Mortality of planted seedlings was high, ranging from 42 to 86 percent at the end of the second growing season. Deaths were attributed to a number of causes, including competition from herbaceous growth (which attains a height of 8 feet in one season), standing water, silting, rabbits, and meadow mice. This second-year mortality dampens somewhat the optimism engendered by the high survivals observed at the end of the first year (87 to 98 percent).

Plans for 1948

Recovery of vegetation on the Ammate-treated milacres and possible toxic effect on the soil will be observed. The three blocks of plots in the scrub oak conversion study will be planted and the course of survival and growth determined during the first growing season. Areas suitable for the direct seeding part of the conversion study will be sought.

FOREST GENETICS

Breeding

The 1947 breeding work, directed mainly toward the production of hybrids between species, was done at the Morris Arboretum in Philadelphia, in cooperation with the University of Pennsylvania. The following species were used for controlled breeding in 1947:

Acer platanoides, A. Mayri, A. saccharum, A. Rubrum
A. saccharinum, A. Henryi, A. negundo

Carya ovata, C. Tomentosa.

Fraxinus chinensis, F. americana, F. pennsylvanica,
F. velutina, F. excelsior, F. oxycarpa.

Liriodendron tulipfera.

Quercus velutina, Q. borealis, Q. robur, Q. alba,
Q. dentata.

Tilia heterophylla, T. tomentosa, T. petioleris.

Abies nordmanniana, A. homolepis, A. cephalonica, A. concolor.

Pinus koraliensis, P. cembra, P. flexilis, P. parviflora, P. peuce, P. Griffithi, P. strobus, P. Bungeana, P. cembroides var. edulis, P. nigra.

A summary of the type, extent, and success of the breeding work is presented in table 8.

The most successful maple crosses were those between the box elder and the sugar maples. It is hoped that some of the resultant hybrids will possess hybrid vigor (i.e. rapid growth) and combine the ability of box elder to thrive on poor soils with the high wood-quality of the sugar maple.

Most of the ash trees used in breeding were severely damaged by a late spring frost which occurred shortly after pollination; all the flowers and leaves on these trees were killed. Fortunately, one tree matured considerable seed to cross pollination between the valuable white ash and the green ash. This cross is promising because of the possibility that the seedlings will possess hybrid vigor.

The breeding work with oaks and hickories was aimed primarily at developing successful techniques for controlled pollination. The results of intraspecific crosses on white oaks indicate that successful controlled breeding will require the use of vegetable parchment bags and careful selection of parent trees for fruitfulness. The hickory pollinations failed completely.

The improvement objective for the true firs was twofold; the production of hybrid types resistant to the spruce budworm, and types suitable for Christmas tree planting south of the present range of balsam fir. Since apomictic cones (cones produced without pollination) occurred on all parent trees, it would be necessary to germinate the seeds before the relative success of the controlled breeding can be evaluated.

The pine breeding work was largely confined to crosses between our native white pine and various Asiatic and European white pines possessing some degree of blister rust resistance, straightness of trunk, or fineness of branch. It is desirable to transfer any or all of these characters to the native species. Since the cones will not ripen until the fall of 1948 it is impossible at present to predict the degree of success.

Table 8.--Summary of controlled breeding for 1947

Species	Controls[1]	Type of pollination		
		Self[2]	Intra-Specific[3]	Inter-Specific
Acer (Maple)				
No. parents[5]	12T-5S	3T-5S	19T-4S	31T-7S
No. flowers worked	2600	200	2200	17,300
No. seeds matured	1	9	396	87
Carya (Hickory)				
No. parents	6T-2S	2T-2S	3T-1S	5T-2S
No. flowers worked	115	44	48	135
No. seeds matured	2	0	0	0
Fraxinus (Ash)				
No. parents	6T-4S	3T-1S	11T-3S	19T-6S
No. flowers worked	3100	900	7300	21,200
No. seeds matured	0	4	592	137
Liriodendron (Tuliptree)				
No. parents	2T-S1	2T-S1	2T-S1	
No. flowers worked	11	30	17	
No. seeds matured	1100	1300	1100	
Quercus (Oak, Red)				
No. parents	2T-2S	1T-1S	8T-2S	8T-2S
No. flowers worked[6]	226	123	666	324
Quercus (Oak, White)				
No. parents	5T-3S	4T-3S	5T-2S	5T-2S
No. flowers worked	138	120	503	1198
No. seeds matured	0	1	14	0
Tilia (Basswood)				
No. parents	3T-3S	4T-3S	2T-1S	4T-3S
No. flowers worked	64	580	270	390
No. seeds matured	0	10	6	38
Abies (Fir)				
No. parents	3T-3S	2T-2S		4T-4S
No. flowers worked	14	12		52
No. seeds matured	2500	1000		9100
Pinus (Pine)				
No. parents	14T-7S	6T-5S	16T-4S	24T-11S
No. flowers worked[6]	90	33	234	746

1/ Female flowers bagged (emasculated where necessary) left unpollinated as checks on technique and occurrence of apomixis (fruit setting without pollination).

2/ Female flowers pollinated with pollen from the same tree.

3/ Pollinations between different trees of the same species.

4/ Pollinations between trees of different species.

5/ Number of trees and number of species used. 12T-5S indicates that 12 trees representing 5 species were used as parents.

6/ The red oaks and pines will not mature their seeds until the fall of 1948.

Only the one native species of yellow poplar is available for breeding. A large number of seeds (1,100) were set to unpollinated controls on this species. If these seeds are viable it will indicate apomixis or possibly faulty technique; if they are non-viable, it will indicate parthenocarpy (fruit production without pollination).

As a corollary to the breeding work, a series of tests were made on the distances of pollen dispersion in species of pine and cedar. Such information is essential to determine the amount of isolation necessary in the establishment of seed orchards and in the genetic improvement of managed stands by means of selected seed trees. Under the conditions of these tests, about 85 percent of the pollen came to rest within 200 feet of the parent trees. This is contrary to the popular belief that winged conifer pollen travels long distances in quantity. According to these preliminary results, isolation distances of one or two thousand feet will be sufficient to effect practical control of the male parents.

Variation among the new hybrid poplars in susceptibility to Japanese beetle damage has been observed for several years in Connecticut, Pennsylvania, and Maryland. This was confirmed and clarified by observations during the year in the propagation nursery at the Chesapeake Branch.

The nursery contains 102 different poplar hybrids spaced 2 feet by 4 feet in plots randomly distributed in two blocks. Japanese beetle infestation in the vicinity was heavy during the summer and as late as September 9 as many as 10 to 12 beetles per leaf were counted on the most susceptible clones.

Although many parentages are represented in the 102 hybrids, beetle feeding was confined to only 9 hybrids representing the following parentages.

PARENTAGE NO. 1
Populus charkowiensis x *P. balsamifera virginiana*
Three susceptible hybrids.

PARENTAGE NO. 2
Populus charkowiensis x *P. caudina*.
Four susceptible hybrids.
One apparently non-susceptible hybrid.

PARENTAGE NO. 3
Populus charkowiensis x *P. berolinensis*.
One susceptible hybrid.
One apparently non-susceptible hybrid.

PARENTAGE NO. 4
Populus Simonii x *P. berolinensis*.
One susceptible hybrid.
One apparently non-susceptible hybrid.

These results derive importance from the fact that they demonstrate differences in palatability to insects between sister hybrids of the same parent trees. Such differences were not expected, particularly for an insect with feeding habits as catholic as those of the Japanese beetle.

There is thus opened up the prospect of breeding for resistance or unpalatibility to a particular insect, such as the spruce budworm, with more restricted tastes.

Plans for 1948

As part of the general reexamination and reanalysis of the problems and program in Forest Genetics, the breeding work, for genera other than poplars, will be reviewed and a realistic program formulated that will be consistent with and allow time for the high-priority poplar work. Two general problems suggest themselves, the breeding of hardwoods that will survive and grow on open, grassy sites without ground preparation, and the development of a disease- and insect-resistant white pine.

The sugar maple growing at the Hopkins Memorial Experimental Forest, the sap of which averaged approximately 8 percent sugar during the 1941 season, will be tested, if possible, during the 1948 sugar season. The Hopkins Experimental Forest staff will make daily sap tests with the saccharimeter throughout the 1948 sugar season on 5 to 10 of the trees worked in 1941. If the extra-sweet tree still shows promise, it may be revegetatively propagated and used for breeding.

The hybrid poplars in the propagating nursery at the Chesapeake Branch will be again observed for Japanese beetle attack.

Field Tests

Hybrid Poplars

Increased propagation of hybrid poplars was started on the Beltsville Experimental Forest in the spring as preparation for extensive field plantings on the other experimental forests of the Station. The disastrous fires of last fall on the Massabesic Experimental Forest, for example, present at once a challenge and opportunity. Large areas must be planted immediately, providing space for extensive tests of the hybrids. The Anthracite Region is another locality where successful hybrids can contribute greatly to the forest problems.

A total of 250 hybrid poplar clones, selected as worthy of tests for disease and insect resistance and for ultimate field trials throughout the Northeast, are being propagated. For 100 of these clones sufficient cutting stock was available to establish one plot (and in most cases, 2 plots) of 50 trees each. These plants will be maintained as

stools for the production of the cuttings for the field trials. Many of the clones averaged 7 to 9 feet height growth the first year from dormant 12 inch cuttings; one averaged 10 feet; and the maximum height attained from a 12-inch cutting was 12-1/4 feet.

No hybrids of other genera were available for field testing during the year.

Plans for 1948

Additional plantings of selected hybrids as stools for the production of field planting cuttings will be installed so that adequate supplies may be available by the spring of 1949.

Site preparation for planting in 1949 will be undertaken on the Massabesic Experimental Forest.

Ten poplar clones will be used as one of nine species in a complex experiment on the conversion of scrub oak land in the Anthracite Region.

Racial Variations

In 1937 a plantation of red pine was established in the Allegheny Hardwoods region, in which 50 different seed sources and 9 climatic regions were represented. Its purpose was to determine the best source of planting stock for that region. Examination 5 years later failed to reveal any outstanding differences in either survival or growth.

Analysis of 602 surviving trees in one block of the plantation, measured in 1947, disclosed that some differences are now showing up. Stock from Upper Michigan seed has the best average survival (93 percent). Lower Michigan was slightly below the general average of 86 percent survival, while stock from eastern seed sources ranked fourth or slightly above the general average. Lower Michigan sources lead in height growth, attaining an average of 10.6 feet, but the Northern Michigan stock ranked next to the bottom. The eastern sources (Maine, Massachusetts, New York, and Pennsylvania), some only 70 miles distant from the test site, ranked seventh of the nine climatic regions in height at 10 years of age. Thus the commonly held idea that local seed sources are best is not borne out by the results to date on this block.

Plans for 1948

Remaining blocks of this plantation will be remeasured early in the year and the data will be compared with the results obtained on the first block.

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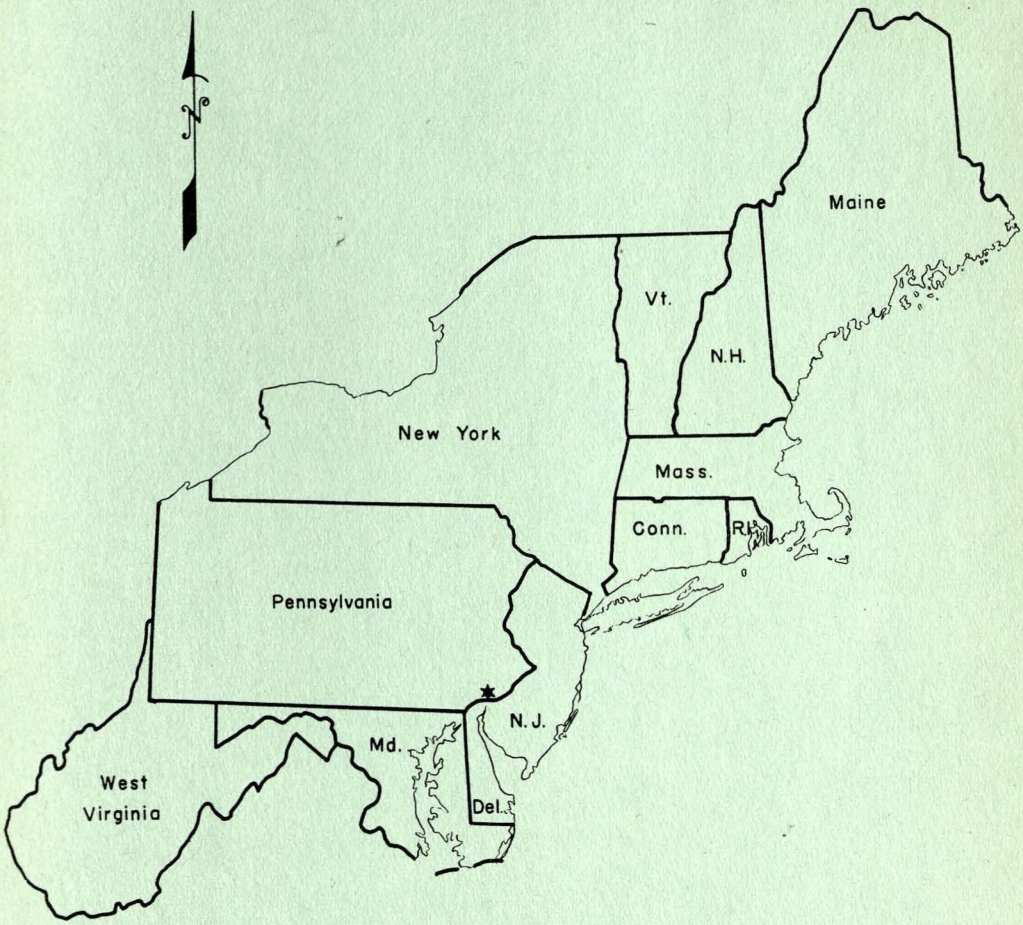

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